TECHNICAL REPORT

December 1989

Sacramento Metropolitan Area Transportation Study

"METRO STUDY"

Sacramento Area Council of Governments

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SACRAMENTO METROPOLITAN AREA TRANSPORTATION STUDY

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DECEMBER 1989

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METRO STUDY TECHNICAL REPORT

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CHAPTER I. EXECUTIVE SUMMARY

Where will we be in the year 2010? In most respects, the forecast for the Sacramento region could not be brighter. The Sacramento area is recognized as one of California and the nation's most desireable places to live. The affordable housing, growing economy, mild climate, and abundance of education, occupation, and recreation opportunities found here have made Sacramento extremely attractive. Although traffic congestion in Sacramento may still seem light when compared to the gridlock found in other major cities, the region's popularity and resulting growth is placing tremendous pressures on the existing transportation system.

The Metro Study clearly illustrates the potential impacts of current land development patterns in the region. While many people are now moving to Sacramento to enjoy the high quality of life, the projected growth has the potential to cause significant traffic problems in the near future. The region's bus and rail system, highways, and bridges--portions of which are already crowded beyond capacity during commute hours--will be called upon to accommodate hundreds of thousands of new commuters.

As has been seen in other areas of the state, traffic congestion can be a threat to economic prosperity, an impedance to further growth and development, and a major contributor to increasingly poor air quality. In general, the problems associated with traffic congestion are often perceived as causing a decline in the overall quality of life. With appropriate planning, Sacramento can avoid many of these problems and maintain the attractive qualities that have drawn so much attention.

In 1986, Sacramento regional policy makers asked SACOG planners to develop a list of transportation improvement projects that would be needed to accommodate traffic projected for the year 2010. SACOG was asked to include in this analysis air quality impacts and order of magnitude costs. After two years of work, the policy makers have approved the Sacramento Metropolitan Area Transportation Study's comprehensive recommendation.

The Metro Study served as a unique forum for the region's planners, engineers, and elected officials to coordinate a study that addresses local and regional needs and concerns. By working in this forum, it became clear that a list of transportation improvements is not a complete response to concerns about the region's congestion. Environmental issues--in particular air quality--and impacts of land use development patterns on congestion must be addressed.

It is clear that air quality and transportation planning must proceed hand in hand, and that future transportation decisions must meet not only traditional transportation needs but also be designed to enhance and protect the region's air quality.

As presented in this report, SACOG's recommendations to the region are designed to ensure that transportation impacts on air quality are further examined, that alternative land use development patterns are explored as a means of reducing travel demand, and that citizens in the next century will be able to travel easily and comfortably.

PURPOSE AND RELATIONSHIP TO OTHER STUDY EFFORTS

The purpose of this study has been to develop a list of priorities for transportation system improvements needed to meet travel demand projected for the year 2010 based on current land use plans. The study's recommendations are designed to assist local officials in transportation planning during the next several years. They are also intended to provide input towards the development of air quality plans and the Urban Airshed Model, as well as updates of the Regional Transportation Plan.

STUDY AREA, PARTICIPATING JURISDICTIONS, AND FUNDING

The study area extends from just south of Elk Grove north to East Nicolaus and Auburn, and from the Yolo bypass east to about Shingle Springs. The entire study area is shown in Map 2.1. Some portions of El Dorado and Placer counties included in the study are outside of the boundaries of the SACOG region. The data for these portions were analyzed on an aggregate basis. As shown on Map 2.1, a slightly larger area was used for computer simulations, and travel statistics presented in this report pertain to this larger area. Transportation projects evaluated in the study are located within the focused study area.

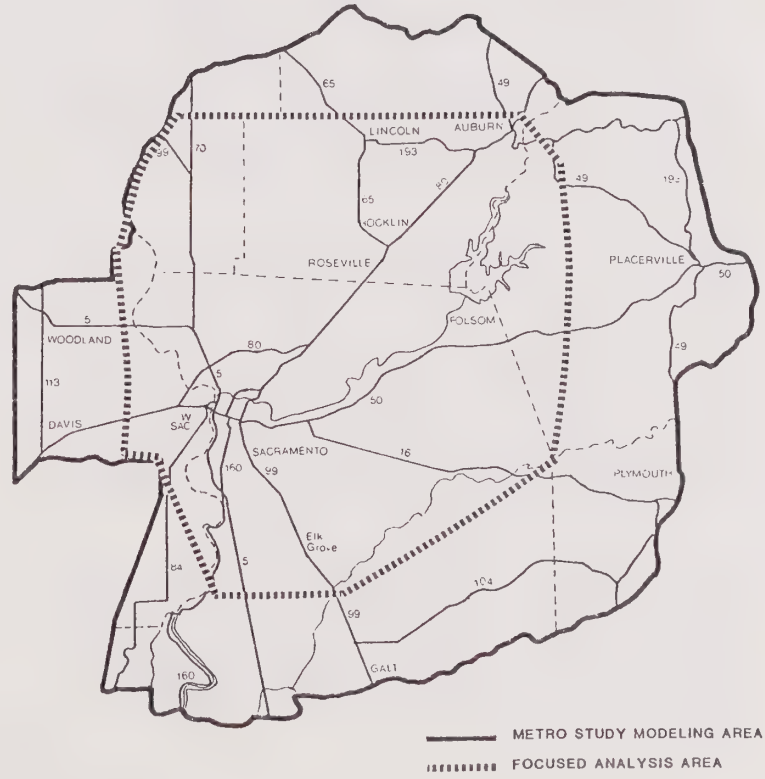
The following jurisdictions and agencies participated in the study:

- County of Sacramento
- County of Placer
- County of El Dorado
- City of Sacramento
- City of Lincoln
- Caltrans District 3
- Sacramento Regional Transit District
- Sacramento Metropolitan Air Quality Management District
- City of West Sacramento
- City of Roseville
- City of Folsom
- City of Rocklin
- Paratransit, Inc.

Funding for the study included monies contributed by the participating jurisdictions, as well as the Federal Highway Administration, the Urban Mass Transportation Administration, and the California Department of Transportation.

MAP 2.1

METRO STUDY AREAS OF ANALYSIS



STUDY METHODOLOGY

Technical Analysis

The analysis focused on:

1. Development of a base transportation system scenario for the year 2010 that would serve as a take-off point in analyzing additional transportation improvements.

2. Comparison of alternative sets of transportation improvements, each representing a different combination of roadway facilities, transit facilities, and transportation control measures.

3. Development of hypothetical land use scenarios to demonstrate how changes in land use development would affect the transportation system.

SACOG developed the base transportation system using socioeconomic projections based on existing general plans and improvements to transportation facilities that were assured of funding. The socioeconomic projections were generated by the SACOG Research Section in coordination with local jurisdictions. By altering development projections between the years 1995 and 2010, the study examined the impacts of changes in land use development patterns.

In performing the analysis, SACOG used a microcomputer-based model. This model consists of a mathematical process that describes the relationship between traffic and socio-economic characteristics. Using MINUTP software, the model was first adjusted to reflect 1984 traffic conditions and then used to calculate traffic characteristics for the year 2010. Although the model is an average daily traffic (ADT) model, it actually simulates an average weekday as do most travel demand models. It also allows analysis of peak hour travel. Given an assumed percentage of daily trips made during the peak hour, various peak hour traffic data can be derived by the model and used in further analysis.

Briefly, three types of analysis were performed on future year alternatives: transportation systems characteristics, weekday statistics, and peak hour statistics. System characteristics include lane miles of freeways or major arterials on a system and route miles of bus and light rail service. Weekday statistics include vehicle miles traveled, total transit trips, total vehicle trips, traffic volumes on selected roadway links, and trip reductions attributable to transportation control measures (TCMs). Peak hour statistics include both vehicle hours of delay and lane miles at designated levels of service.

Public Participation

Three public forums were held at key times during the process leading up to the presentation of the final report. The first forum, held in April 1988, offered the public an opportunity to review plans for the Metro Study and make recommendations on the study process. The second and third forums, held in July 1989, presented the analysis and provided the public with the opportunity to comment before a recommendation was developed. In September 1989, an evening meeting of the Policy Advisory Committee was held to receive comments on the staff and Technical Advisory Committee recommendations.

A series of public service announcements and news releases widely distributed prior to the public forums invited people to attend the forums and to learn more about the Metro Study. A newsletter, published after the April public forum, included a report on the forum and described the direction of the study and the computer technology involved. The newsletter also announced the formation of a Metro Study Speakers' Bureau, talk show appearances by study participants, and other pending activities. A second newsletter, mailed in June 1989, discussed the role of new transit and freeway facilities, and invited the public to the July forums.

SACOG developed a list of influential community leaders recommended by the policy advisory committee. Included on the list were representatives of planning commissions, chambers of commerce, cities and counties, as well as several transportation experts. Meeting with these people individually, SACOG staff presented information about the Metro Study and heard their perspectives regarding the study.

SACOG maintained an open door with the media, making every effort to keep them informed on the progress of the study. Media kits provided detailed information, including maps and charts. In addition, SACOG held numerous individual briefings with reporters who covered the study.

Prior to each public forum, all traffic reporters in the area were contacted and requested to encourage viewers and listeners to attend the forums. Study participants sought opportunities to appear on community affairs and news programs, especially during those periods immediately preceding public forums.

Jurisdiction Participation

A Policy Advisory Committee (PAC) and a Technical Advisory Committee (TAC) were formed to review and direct the progress of the study.

Policy Advisory Committee:

The PAC included one member of the city council or board of supervisors from each of the jurisdictions involved in the study, a Regional Transit (RT) Board member, and the Director of Caltrans District 3. Each of the eleven members had one vote.

Specifically, the charge of the policy committee was to:

- Decide policy issues guiding the study
- Ensure that technical analysis addressed major policy issues
- Assure that key viewpoints were expressed
- Represent the public interest
- Take the results of study back to their individual jurisdictions by placing study approval on their agendas
- Recommend a master list of improvements to the SACOG Board of Directors

Through their elected officials serving on the committee, jurisdictions were able to participate in policy decision-making on issues or recommendations that concerned them.

Technical Advisory Committee:

The TAC consisted of twenty-two voting members, including one high level staff member from each of the planning and public works departments of the affected jurisdictions, two from Caltrans District 3, and two from the Sacramento Regional Transit District. Paratransit, Inc. and Air Quality Management District staff also participated in the meetings.

The charge of this committee was to:

- Review the technical aspects of the study
- Recommend transportation system alternatives
- Facilitate data collection and detailed technical review with individual staff members of each jurisdiction or agency
- Assign order-of-magnitude costs to the various transportation system alternatives

CHAPTER III. DEVELOPMENT OF THE 1984 TRANSPORTATION MODEL

INTRODUCTION

Over the past several years, SACOG has been developing a regional transportation model for the greater Sacramento area. The model has been built using MINUTP, a microcomputer-based gravity model similar to the federal Urban Transportation Planning System (UTPS). The last regional modeling done in the Sacramento area occurred circa 1980 and used UTPS. Caltrans was the lead agency on the former model development; however, under the terms of an informal agreement in the early 1980's, SACOG was designated as the primary modeling agency for this region.

As part of the Metro Study, SACOG has adjusted the previously-developed model to make it descriptive of the 1984 traffic condition. The adjusted model was then used to project travel demand for the year 2010.

This chapter and Appendix A discusses the process, methodology, and assumptions used in developing the 1984 model.

PROCESS OVERVIEW

The modeling process begins with trip generation, which estimates the average number of person trips made each day in each zone. Zones are small geographic areas that constitute the modeling area. These trip estimates are adjusted for zones that contain special trip generators. Special trip generators are hospitals, schools, military bases, airports, and other specific land uses that greatly influence travel demand.

Next, the movement of people between zones is analyzed. This is called the trip distribution stage. It creates a trip table containing the number of person trips originating in one zone with a destination in another zone.

After trip distribution, the process splits the person trips into groups that use the various modes of transportation. The number of person trips using transit is estimated first. The remaining person trips are converted to auto trips. No mode split is calculated for trips entering or exiting the model area. The last phase of the process is the assignment of the auto trips to the transportation network. It is this last step that produces the estimates of traffic volumes and levels of service (LOS).

The model uses trip productions and attractions to define its trips. Trip productions are primarily based on housing projections, while trip attractions are primarily based on employment projections. For example, a trip going from home (origin) to work (destination) is counted as one home-work trip produced by the home end. The return trip from work (origin) to home (destination) is also counted as one home-work trip produced by the home end.

Thus, using the concept of trip productions and attractions, the model counts a home-work trip as a trip produced by the zone where the home is located and attracted by the zone where the work is located. Similarly, the model assumes that all home-based trips (e.g., home-work, home-shop, and home-other) are produced at the home end. All other-work trips are assumed by the model to be attracted to the work end.

A more detailed analysis of the socioeconomic data used in the model, and the trip generation, and trip distribution process is included in Appendix A. The appendix also more closely examines special generator, mode split, external trip estimation, network assignment, and model calibration.

CHAPTER IV. DEVELOPMENT OF THE 2010 TRANSPORTATION MODEL

Once the 1984 base year model was calibrated, adjustments were then made to make projections for the year 2010. The development of the 2010 transportation model focused on development of a 2010 transportation network, and projections of households and employment.

TRANSPORTATION NETWORK

The transit network for 2010 is the 1988 light rail and bus network assuming double-tracking of the light rail lines. The 2010 roadway network includes both existing facilities and those with assured funding. Projects with assured funding are defined as those having identified funding sources, either through normal funding mechanisms or development fees. Figure 4.1 is a listing of roadway projects included on the 2010 Base conditions. It is important to note that because the model was calibrated for 1984 conditions, there are a number of projects on the list that have since been completed.

2010 HOUSING AND EMPLOYMENT ASSUMPTIONS

The 2010 housing and employment assumptions were made over a period of several months with the input of local planners. Following is a brief description of the process followed in developing these projections. More in-depth analysis and a series of tables and charts can be found in Appendix B.

Housing

Each year since 1970, SACOG has developed population and housing projections based on the California Department of Finance (DOF) Population Research Units (PRU) population projections by jurisdiction. The PRU projections are broken down into minor zones, consisting of an average of 1,483 persons and 576 housing units in the base year. Current household vacancy rates and mean household size for each dwelling type (single family and multi-family) are applied to arrive at the number of households by minor zone.

Employment

Employment projections are based on several factors revolving around land use planning, current employment yields for different zoning, and adopted land use plans. The methodology followed looked at currently-vacant land that was zoned for commercial use or was highly likely to be used for commercial purposes. Projections of retail and non-retail employment were made, using current employment yields, or number of employees per acre for a zoning type.

Based on the judgement of SACOG's Research Section, employment was constrained in some areas to a pattern of growth consistent with trends over the last few years. There is also an assumed net migration into the area for jobs in the year 2010.

FIGURE 4.1

2010 BASE ROADWAY PROJECT LISTING

Project No.	Jurisdiction (locale)	Description
1100	Sacramento County	Rt. 99 @ I-5 to Sankey, 2-4 lanes
1131	Sacramento County	Sunrise Blvd. @ American River to Madison Avenue, 4-6 lanes
1132	Sacramento County	Greenback Lane @ I-80 to Sunrise, 4-6 lanes
1134	Sacramento County	Coloma Road @ Sunrise to Hazel, N/A-4 lanes
1135	Sacramento County	Watt Avenue @ Elverta to Elkhorn, 2-6 lanes
1136	Sacramento County	Watt Avenue @ Don Julio to Elkhorn, 4-6 lanes
1138	Sacramento County	Antelope @ Watt to Elverta, 2-4 lanes
1140	Sacramento County	Antelope @ Elverta Road to I-80, 2/4-6 lanes
1141	Sacramento County	Don Julio @ Elkhorn to Placer County line, 2-4 lanes
1142	Sacramento County	Walerga @ Elkhorn to Placer County line, 2-4 lanes
1153	Sacramento County	Sheldon @ Bruceville to Rt. 99, 2/4-6 lanes
1154	Sacramento County	Sheldon @ Franklin to Bruceville Road, N/A-4 lanes
1155	Sacramento County	Bruceville @ Elk Grove Blvd. to Sheldon, 2-6 lanes
1156	Sacramento County	Bradshaw Road at Kiefer to Folsom Blvd., 2-6 lanes
1159	Sacramento County	Elk Grove Blvd. @ Franklin to Bruceville, 2-4 lanes
1160	Sacramento County	Elk Grove @ Bruceville to Elk Grove/Florin, 2-6 lanes
1162	Sacramento County	Rt. 99 @ Bond Road to Laguna Blvd., Part-full I/C
1164	Sacramento County	Bighorn @ Elk Grove Blvd to Sheldon, N/A-4 lanes
1165	Sacramento County	Laguna Blvd @ Franklin to Bighorn, N/A-6 lanes
1166	Sacramento County	Laguna @ Bighorn to Rt. 99/Bond Rd I/C, N/A-8 lanes
1168	Sacramento County	Power Inn Rd @ Gerber to Calvine, N/A-4 lanes
1169	Sacramento County	Elsie @ Power Inn to Stockton, 2-4 lanes
1176	Sacramento County	White Rock Rd @ Zinfandel to Sunrise, 2-6 lanes
1177	Sacramento County	Zinfandel @ White Rock to Olsen, 2-6 lanes
2110	Sacramento City	Truxel @ San Juan to I-80 to Del Paso, N/A-6 lanes, I/C
2111	Sacramento City	No. Market Street Extension to I-5, N/A-4 lanes I/C
2116	Sacramento City	Rt. 160 @ Richards, Part-full I/C
2117	Sacramento City	Richards Blvd @ I-5 to N. 12 Street, 2-4 lanes
2151	Sacramento City	I-5 @ River Bend O/C, O/C-I/C
2152	Sacramento City	Rt. 99 @ Sacramento Blvd to Florin Rd, 6-8 lanes
2156	Sacramento City	Cosumnes River Blvd. I-5 to Elk Grove/Florin Rd., 2 lanes
3126	Folsom	Bidwell @ Coloma to Rt. 50, 2-4 lanes
3127	Folsom	Oak Ave Pkwy @ Bidwell to Natoma, N/A-4 lanes
3128	Folsom	Blue Ravine Rd @ Natoma to Folsom Blvd, N/A-4 lanes
4126	Roseville	Douglas @ Sierra College Blvd to Sunrise, 4-6 lanes
4127	Roseville	Harding @ below Atlantic to Rt 65 Bypass, N/A-2 lanes
4128	Roseville	Harding @ Douglas to Atlantic, 2-4 lanes
4129	Roseville	Atlantic @ I-80 to Vernon Street, 2-4 lanes
4131	Roseville	Rt 65 @ I-80 to Washington Blvd, N/A-4 lanes

FIGURE 4.1 -- CONTINUED

Project No.	Jurisdiction (locale)	Description
4132	Roseville	Rt 65 Bypass @ Blue Oaks, Harding, Carlsberg, at Grade-Diamond I/C
4133	Roseville	Rocky Ridge @ Douglas to E. Roseville Pkwy, N/A-4 lanes
4134	Roseville	Carlsberg at Cook - Riolo to Sunset, N/A-4 lanes
4135	Roseville	Cook-Riolo @ Baseline Rd to Blue Oaks Blvd, N/A-2 lanes
4136	Roseville	Junction Blvd @ Foothills Rd to Cook Riolo Rd, N/A-2 lanes
4137	Roseville	Foothills @ Atkinson to Roseville/Cirby, N/A-2 lanes
4138	Roseville	Sunrise @ Douglas to E. Roseville Parkway, N/A-4 lanes
4139	Roseville	Eureka Rd @ Sierra Col. Blvd to Atlantic/I-80, N/A-2 lanes
4140	Roseville	E. Roseville Pkwy @ Sierra College to Washington, N/A-2 lanes
4141	Roseville	Rocky Ridge @ Douglas to E. Roseville Parkway, 2-4 lanes
5126	Rocklin	Rocklin Rd @ 5th to Whitney, N/A-4 lanes
5127	Rocklin	Rocklin Rd @ Granite to 5th, 4-6 lanes
5128	Rocklin	Granite @ Rocklin Rd to Sierra College Blvd, N/A-4 lanes
5129	Rocklin	Sierra College Blvd @ Rocklin Rd to Taylor, 2-4 lanes
5130	Rocklin	Sunset @ Whitney to Rt 65, 2-4 lanes
5131	Rocklin	Pacific @ I-80 to Sierra College Blvd, 2-4 lanes
5132	Rocklin	Del Mar @ Argonaut Exit to Pacific, 2-4 lanes
5133	Rocklin	Argonaut @ Midas to Del Mar, N/A-2 lanes
5134	Rocklin	Stanford Ranch Road
6126	Lincoln	Nicolaus Rd @ N-S Parkway to Aviation Blvd, 2-4 lanes
6127	Lincoln	N-S Parkway @ Nicolaus to Moore Road, N/A-4 lanes
9151	West Sacramento	Industrial Blvd @ Parkway Blvd to Enterprise, N/A-2 lanes

CHAPTER V. ALTERNATIVES ANALYSIS

INTRODUCTION

In order to develop a list of projects that best serves the needs of the Sacramento region in the year 2010, the Metro Study analyzed six alternative transportation scenarios. The alternatives were derived from a master list of possible transportation improvements envisioned for the year 2010. The master list of projects included five light rail transit (LRT) extensions, two new major freeways: Routes 65/148 (a circumferential freeway) and Route 102 (parallel to I-80 between I-5 and Auburn), additional bridges across the American River and an extensive list of freeway and surface street improvements.

In addition to system improvements, a reduction of vehicle trips through the use of transportation control measures (TCMs) was assumed in each of the alternatives. The alternatives were compared to the funding-restricted 2010 Base Network to measure the degree of effectiveness in relieving the projected traffic congestion.

Selection of Alternative Scenarios for Analysis

Each alternative was built around a particular transportation emphasis and was designed to enhance the analysis of the anchor projects and their impact on the region-wide transportation system (see Map 5.1). The approach used in developing the alternative transportation systems was two-fold: a general breakdown of "anchor projects" and determination of the smaller scale projects to be tied to the anchors. Projects were included in the alternatives, as listed by individual jurisdictions, until LOS F had been eliminated from all roadways where a potential improvement was listed. In addition to the six alternative transportation scenarios, SACOG developed a demonstration scenario to illustrate the fact that different land use development patterns create different demands on a transportation system.

Brief Description of Alternatives

As indicated above, each alternative includes an extensive list of freeway and surface street improvements which complement the anchor project. Below is a description of the alternatives and the anchor projects they include. Figure 5.1 is a matrix showing each of the projects included in each alternative. The makeup of each alternative is discussed in depth later in the chapter.

Alternative One is based on the expansion of five light rail transit lines, implementation of an extensive TCM program and a comprehensive package of bus system improvements. Three LRT extensions and implementation of a moderate TCM program are included in Alternatives Two and Three to compliment the anchor projects Routes 65/148 and Route 102, respectively. Alternative Four includes both Routes 65/148 and 102 in addition to implementation of a moderate TCM program and three LRT extensions while Alternative Five is limited to three LRT extensions, moderate TCMs, and surface street and freeway widenings. Alternative Six includes the most extensive list of anchor projects: five LRT extensions, implementation of extensive TCM programs, a comprehensive package of bus system improvements, and Routes 65/148 and 102.

METHODS OF ANALYSIS

To evaluate the congestion projected on the 2010 base and measure the degree of relief each alternative provides, analysis includes transportation system characteristics, weekday and peak-hour statistics, volumes, and order-of-magnitude costs. The methods of analysis are defined below and discussed fully later in the chapter. The Metro Study was originally intended to include analysis of air quality impacts and order-of-magnitude cost benefit ratios; however, through development of the study, it became clear that these could not be included. An analysis of air pollutant emissions was included. (See discussion on following page.)

Transportation System Characteristics

In addition to a written or verbal description of the make-up of each alternative, four types of system characteristic information are compiled to compare the alternatives.

Lane Miles: Roadway distance times the number of lanes.

Light Rail System Miles: Number of miles in the light rail system, not route miles. For example, two or more LRT service lines using the same one mile of track counts as one system mile.

Bus Line Miles: The sum of each bus line's total distance. For example, four buses using the same one mile stretch of roadway count as four bus line miles. Bus line miles have decreased since 1984 due to service changes related to implementation of light rail service.

Weekday Statistics

Weekday statistics provide an indication of the overall daily travel demand estimated by the model.

Vehicle Miles Traveled: This is the sum of each link's daily traffic volume times its distance. The figure given is for an average 24-hour period. A lower VMT appears to be due, in large part, to the trip reduction caused by extensive use of transportation control measures.

Total Transit Trips: Transit trips are projected for the home-work trip; other transit trips are derived as a percentage of the home-work number. Transit trips do not reflect boardings (e.g., one transit trip may have two transfers and, therefore, have three transit boardings).

Total Vehicle Trips: Total vehicle trips are projected on a daily basis.

Transportation Control Measure Trip Reduction: This reduction is estimated as a percentage of total daily vehicle trips.

Peak-Hour Statistics

Although the Metro Study used an Average Daily Trip (ADT) model, estimates were made to determine the number of trips in a peak hour. From this, the following type of peak-hour statistics were derived.

Vehicle Hours of Delay: Vehicles are considered to be delayed when they are traveling at less than 65 percent of free-flow capacity. A lower number of delay hours can be due to reduced number of trips in the peak hour or increased speeds.

Level of Service (LOS): LOS indicates the relationship between projected traffic volumes and estimated roadway capacity. LOS A represents free-flow traffic and LOS F reflects traffic projections in excess of estimated capacity. As broken down in the individual alternatives analysis for freeways, LOS F0 - F3 indicate the relative length of LOS F, with F0 being 15 minutes to 1 hour and F3 being greater than 3 hours.

Volumes

Projected average daily volumes were tabulated for numerous locations on the network in order to evaluate the impact of the alternatives on specific road segments.

Costs

This is the total estimated capital cost of all roadway and transit projects. These costs do not include cost for development and implementation of a TCM package or operation and maintenance of the roadway or transit systems.

Air Pollutant Emissions Analysis

An analysis was completed by the Air Resources Board of the relative impacts of the base case and the six alternatives on air pollutant emissions. While all scenarios showed significant emission reductions in the year 2010 from 1984 levels, the emissions appear to increase from current (1989) levels. Such emission increases would work against the attainment of air quality standards.

The average daily emissions (in tons) for 1984, 1989, and the 2101 projection and alternatives were calculated as functions of emissions attributable to unrestricted travel and those emissions produced during increased vehicle hours of delay (congestion). For purposes of comparison, emissions were also calculated for two additional alternatives, one assuming no growth in vehicle miles travelled per trip over 1984 levels and the other in which the growth rate in vehicle miles travelled per trip was held equal to the population growth rate.

Cost/Benefit Analysis

Both the Technical and Policy Advisory Committees determined that the limited type of information available in this area was not appropriate for use in the decision-making process. Although cost/benefit analysis of alternatives is not available, order-of-magnitude costs are given for each project and the alternatives as a whole.

ANALYSIS HIGHLIGHTS

This section provides an overview of the more in-depth analysis of each alternative found in remaining sections of the chapter, and highlights the data of Figure 5.2 - Evaluation Criteria Matrix; Figure 5.3, and Figure 5.4 - Volumes; Map 5.2 - Volume Comparison Locations; Figure 5.5 - Cost Estimates; and Figures 5.6 - 5.7 - Level of Service for Freeways and Major Arterials.

Alternative One provides significant relief across the system, particularly in terms of vehicle miles traveled and vehicle hours of delay reduction. It also reduces volumes on a number of the major roadway facilities and has excellent transit ridership due to the extended transit system and mandatory TCMS. The number of lane miles at LOS F is not dramatically lower than other alternatives. Aside from the cost of developing and implementing TCM programs, which has not been estimated, it is one of the less expensive alternatives.

Alternatives Two and Three are not outstanding in any one category, and they are mid-range in cost. Alternative Four, which included both Routes 102 and 65/148 provides fairly significant decreases in volumes on much of the roadway system. It also shows only 385 freeway lane miles at LOS F. The overall impact of this alternative appears to be limited by its lack of expanded transit and mandatory TCMs. The cost is one of the highest, at an estimated $2 billion.

Alternative Five provides the least amount of relief at the lowest cost. Although most forms of measurement show the system to be performing far better than the 2010 Base, each other alternative provides better relief for the system. The estimated cost is $1 billion.

Alternative Six provides the greatest relief at the highest cost. Lane miles at LOS F is lower on this alternative than any other, and volumes are lower at more points across the roadway network. Because of the expanded transit and mandatory TCMs, roadway trips are fewer, therefore, the VMT is lower. The combination of Routes 102 and 65/148, expanded transit, and mandatory TCMs provide fewer hours of delay on the system. The estimated cost is $2.3 billion. As with Alternative One, this figure does not included the cost to develop and implement mandatory TCM programs.

MAP 5.1

ANCHOR PROJECTS
FOR FUTURE-NETWORK ALTERNATIVES

1. Multi-modal corridor
2. Multi-modal corridor
3. Light Rail Extensions
4. Additional river crossing @ Folsom
5. Additional river crossing between Watt Avenue and Sunrise
6. Additional river crossing @ 7th to Truxel
7. Route 65 bypass @ Lincoln
8. Route 193 bypass @ Lincoln
9. Widening of existing freeways and major arterials, to be determined

NOTE: All Routes are approximate.

FIGURE 5.1

ALTERNATIVE PROJECTS LIST

Project	Jurisdiction (locale)	Description	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
Transit								
T	Sacramento County	LRT Extension on I-80 to Antelope Road	X	X	X	X	X	X
T	Sacramento County	LRT Extension on Rt. 50 to Hazel Avenue	X	X	X	X	X	X
T	Sacramento County	LRT Extension on Meadow-view and Calvine Roads	X	X	X	X	X	X
T	Sacramento County	LRT Extension to North Natomas	X					X
T	Sacramento County	LRT Extension to West Sacramento	X					X
Freeway and Highway Improvements								
1240	Sacramento County	I-80 @ Madison Ave. to Riverside Blvd., 6/8-8/10 lanes	X	X	X	X	X	X
1257	Sacramento County	Rt. 16 @ Manlove to Tree View Road, 2-4 lanes	X	X	X	X	X	X
1275	Sacramento County	Rt. 99 @ Florin Rd. to Elk Grove Blvd., 4-6 lanes	X	X	X	X	X	X
1277	Sacramento County	Rt. 50 @ Sunrise Blvd. to Folsom Blvd., 6-8 lanes	X	X	X	X	X	X
1284	Sacramento County	Rt. 16 @ Tree View Road to Rancho Murieta, 2-4 lanes	X	X	X	X	X	X
2202	Sacramento City	Business 80 @ E St. to Rt. 160, 6-8 lanes	X	X	X	X	X	X
2206	Sacramento City	I-5 @ I-80 to Rt. 99, 6-8 lanes	X	X	X	X	X	X
2220	Sacramento City	I-80 @ I-5 to Watt Ave., 6-8 lanes	X	X	X	X	X	X
3230	Folsom	Rt. 50 @ Folsom Blvd. to El Dorado Co., 6-8 lanes	X	X	X	X	X	X
3226	Roseville	I-80 @ E. Roseville O/C to Sierra College Blvd., 6-8 lanes	X	X	X	X	X	X
4234	Roseville	Rt. 65 @ Blue Oaks Blvd to South Lincoln, 2-4 lanes	X	X	X	X	X	X
New Facilities								
1200	Sac./Placer Counties	Rt. 102 @ I-5 to I-80, 6 lanes			X	X		X
1201	Sacramento County	Rts. 65/148 (Beltway) @ I-80 to Rt. 50 to Rt. 99 to I-5, 6 lanes		X		X		X
1207	Sacramento County	I-5 @ Metro Airport Rd., Interchange	X			X		X
1252	Sacramento County	Elk Grove/Florin Rd. @ Bond Road to Rt. 16, 2-4 lanes						X
1253	Sacramento County	Elk Grove Blvd. @ I-5 to Franklin Blvd., 0-2 Lanes	X					
1276	Sacramento County	Rt. 50 @ Gold River Rd., Interchange		X	X		X	X
1278	Sacramento County	American River crossing between Watt Ave. and Sunrise Blvd., 6 lanes	X				X	X
1286	Sacramento County	Mayhew Rd. @ Kiefer Blvd. to Rt. 16, 4 lanes	X				X	X
2200	Sacramento City	I-5 @ S Street, new ramps	X			X		X
2201	Sacramento City	Richards Blvd. @ Rt. 160 to Business 80, 4 lanes		X		X	X	X
2204	Sacramento City	Expo Blvd.@ Business 80 to Rt. 160, 4 lanes			X		X	

FIGURE 5.1--CONTINUED

ALTERNATIVE PROJECTS LIST

Project	Jurisdiction (locale)	Description	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
2205	Sacramento City	Extension of Truxel Ave. across American River to Downtown, 4 lanes	X		X			X
2219	Sacramento City	Arden Way to Garden Hwy. connector, 4 lanes			X	X	X	X
2250	Sacramento City	Fruitridge Rd. @ Power Inn Rd. to El Grove/Florin Rd., 8 lanes		X	X			
3327	Folsom	Bridge - Oak Avenue Extension, 4 lanes			X	X	X	
3231	Folsom	Folsom Blvd. to Folsom-Auburn Road, 4 lane bridge	X	X	X	X		X
4216	Roseville	Atlantic Street extension, 6 lanes		X		X		X
6226	Lincoln	Rt. 65 Bypass, 4 lanes		X		X		X
6227	Lincoln	Rt. 193 Bypass, 4 lanes	X				X	
6230	Lincoln	Foothills Blvd. @ Blue Oaks Blvd. to Rt. 65, 4 lanes	X			X		
Surface Street Improvements								
1202	Sacramento County	Howe Ave. @ Fair Oaks Blvd. to Alta Arden Expwy., 4-6 lanes	X	X		X	X	X
1206	Sacramento County	Elverta Rd. @ Rio Linda Blvd. to Metro Airport, 2-4 lanes			X	X	X	
1209	Sacramento County	Elkhorn Blvd. @ 6th St. to Walerga Rd., 2-4 lanes	X	X	X	X	X	X
1210	Sacramento County	Elkhorn Blvd. @ I-80 to Don Julio Blvd., 4-6 lanes	X	X	X	X	X	X
1226	Sacramento County	N. Antelope Rd. @ Antelope Rd. to Placer Co. Line, 2-4 lanes			X	X	X	X
1227	Sacramento County	Fair Oaks Blvd. @ Watt Ave. to Eastern Ave., 4-6 lanes	X	X	X	X	X	X
1231	Sacramento County	Oak Ave. @ Sunrise Blvd. to Illinois/Hickory Ave., 2-4 lanes	X	X	X	X	X	X
1232	Sacramento County	Oak Ave. @ Illinois/Hickory Ave. to Folsom City Limits, 2-6 lanes	X	X	X	X	X	X
1233	Sacramento County	Hazel Ave. @ Oak Ave. to Placer Co. Line, 2-4 lanes	X	X		X	X	X
1234	Sacramento County	Hazel Ave. @ Madison Ave. to Folsom Blvd., 4-6 lanes			X	X	X	X
1235	Sacramento County	Sunrise Blvd. @ Greenback Lane to Placer Co. line, 4-6 lanes	X	X	X	X	X	X
1236	Sacramento County	Sunrise Blvd. @ American River Bridge, 4-6 lanes	X	X	X	X	X	X
1237	Sacramento County	Watt Ave. @ Arden Way to American River Bridge, 4-6 lanes	X	X	X	X	X	X
1239	Sacramento County	Madison Ave. @ Sunrise Blvd. to Hazel Ave., 4-6 lanes	X	X	X	X	X	X
1242	Sacramento County	Watt Ave. @ American River to Folsom Blvd., 4-6 lanes	X	X	X	X	X	X
1247	Sacramento County	Old Auburn Rd. @ Sylvan Rd. to Fair Oaks Blvd., 2-4 lanes	X	X	X	X	X	X
1248	Sacramento County	Wachtel Way @ Oak Ave. to Old Auburn Rd., 2-4 lanes			X		X	X
1249	Sacramento County	Antelope Rd. @ I-80 to Old Auburn Rd., 4-6 lanes	X	X	X	X	X	X
1250	Sacramento County	Greenback Lane @ Fair Oaks Blvd. to Hazel Ave., 4-6 lanes	X	X	X	X	X	X
1252	Sacramento County	Elk Grove/Florin Rd. @ Bond Rd. to Rt. 16, 2-4 lanes	X	X	X	X	X	
1255	Sacramento County	Bond Rd. @ Rt. 99 to Elk Grove/Florin Rd., 2-4 lanes	X			X		X
1256	Sacramento County	Elder Creek Rd. @ Power Inn Rd. to Elk Grove/Florin Rd., 2-4 lanes	X	X	X	X	X	X
1260	Sacramento County	Kiefer Blvd. @ Florin-Perkins Rd. to S. Watt Ave., 2/4-4/6 lanes	X	X	X	X	X	X

FIGURE 5.1--CONTINUED

ALTERNATIVE PROJECTS LIST

Project	Jurisdiction (locale)	Description	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
1261	Sacramento County	Old Auburn Rd. @ Fair Oaks Blvd. to Placer Co. Line, 2-4 lanes			X		X	X
1262	Sacramento County	Madison Ave. @ Air Base Dr. to I-80, 4/6-8/10 lanes	X	X	X	X	X	X
1264	Sacramento County	Greenback Ln. @ I-80 to Sunrise Blvd., 4-6 lanes	X	X	X	X	X	X
1265	Sacramento County	Elk Grove/Florin Rd. @ Bond Rd. to Emerald Pk., 2-4 lanes	X	X	X	X	X	X
1266	Sacramento County	Elk Grove Blvd. @ Elk Grove/Florin Rd. to School Rd., 2-4 lanes					X	X
1267	Sacramento County	Calvine Rd. @ Rt. 99 to Elk Grove/Florin Rd., 4-6 lanes	X	X	X	X		X
1281	Sacramento County	47th Ave. @ Franklin Blvd. to Rt. 99, 4-6 lanes	X	X	X	X	X	X
1282	Sacramento County	Sacramento Blvd. @ Franklin Blvd. to 47th Ave., 2-4 lanes	X	X	X	X	X	X
1285	Sacramento County	Mayhew Rd. @ Rt. 50 to Kiefer Blvd., 2-4 lanes						X
2203	Sacramento City	Bell Ave. @ Norwood Ave. to Marysville Blvd. 2-4 lanes	X	X	X	X	X	X
2207	Sacramento City	Bell Ave. @ Marysville Blvd. to Raley St., 2-6 lanes			X	X		X
2209	Sacramento City	Northgate Blvd. @ Rt. 160 to El Camino Ave., 2-4 lanes		X	X	X	X	
2210	Sacramento City	Truxel Rd. @ El Camino Ave. to Garden Hwy., 2-4 lanes	X		X	X	X	X
2212	Sacramento City	Del Paso Blvd. @ Truxel Rd. to El Centro Rd., 2/6-8 lanes	X	X	X	X	X	X
2214	Sacramento City	El Camino Ave. @ Roseville Rd. to Howe Ave., 4-6 lanes	X	X	X	X	X	X
2215	Sacramento City	E. El Camino Ave. @ I-5 to I-80, 2-6 lanes	X	X	X	X	X	X
2217	Sacramento City	Raley Blvd. @ I-80 to Elkhorn Blvd., 2/4-4/8 lanes	X	X	X	X	X	X
2218	Sacramento City	Garden Hwy. @ I-5 to Northgate Blvd., 2-4 lanes	X	X	X	X	X	X
2221	Sacramento City	Norwood Ave. @ I-80 to Main Ave., 2-4 lanes	X	X	X	X	X	X
2223	Sacramento City	Norwood Ave. @ Arcade Creek, 4-6 lanes	X	X	X	X	X	X
2224	Sacramento City	Franklin Blvd. @ Sutterville Rd. to Fruitridge., 4-6 lanes	X	X	X	X	X	X
2251	Sacramento City	Florin/Perkins Rd. @ Folsom Blvd. to Florin Rd., 2-8 lanes	X	X	X	X	X	X
2252	Sacramento City	Power Inn Rd. @ Gerber Rd. to Elder Creek Rd., 2-6 lanes	X	X	X	X	X	X
2253	Sacramento City	Jackson Rd. @ Folsom Blvd. to Elk Grove/Florin Rd., 2-4 lanes	X	X	X	X	X	X
2256	Sacramento City	Meadowview Rd. @ Freeport Rd. to WPRR, 4-6 lanes	X	X	X	X	X	X
2257	Sacramento City	Power Inn Rd. @ Folsom Blvd. to Fruitridge Rd., 4-6 lanes	X	X	X	X	X	X
2260	Sacramento City	Arden Way @ Fair Oaks Blvd. to terminus, 2-6 lanes	X	X	X			X
2261	Sacramento City	Cosumnes River Blvd. @ I-5 to Elk Grove-Florin Rd., 6 lanes	X	X		X	X	X
3228	Folsom	Folsom-Auburn Rd. @ Folsom Dam Rd. to Placer Co. line, 2-4 lanes	X		X			X
3229	Folsom	Folsom Blvd. @ Riley St. to Rt. 50, 2-4 lanes	X	X	X	X		X
4219	Roseville	Carlsberg Blvd., 4-6 lanes	X	X	X	X	X	X
4220	Roseville	Foothills Blvd, 2-6 lanes	X	X	X	X	X	X
4221	Roseville	Sunrise Blvd. @ Cirby Way to County Line, 4-6 lanes	X	X	X	X	X	X
4222	Roseville	Cirby Way @ Foothills Blvd. to Sunrise Blvd., 4-6 lanes	X	X	X	X	X	X
4223	Roseville	Douglas Blvd. @ Folsom/Auburn Rd. to Hazel Ave., 2-4 lanes	X	X	X		X	
4225	Roseville	Roseville Pkwy. @ Rt. 65 to Douglas Blvd., 2-6 lanes	X		X		X	X
4227	Roseville	Industrial Way @ Washington Blvd. to Blue Oaks Blvd., 2-4 lanes	X	X		X	X	X
4228	Roseville	Washington Blvd. @ Junction Blvd. to Blue Oaks Blvd., 2-4 lanes	X	X	X	X	X	X

FIGURE 5.1--CONTINUED

ALTERNATIVE PROJECTS LIST

Project	Jurisdiction (locale)	Description	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
4229	Roseville	Main St. @ Atkinson St. to Washington Blvd., 2-4 lanes		X	X	X	X	
4231	Roseville	N. Antelope @ Dry Creek Rd. to Blue Oaks Extension, 2-4 lanes		X	X	X	X	X
4232	Roseville	Eureka Rd. @ Douglas Blvd. to Sierra College Blvd., 4-6 lanes					X	
4236	Roseville	Stanford Ranch Rd. @ Sunset Blvd. to Douglas Blvd., 2/4-6 lanes	X	X	X	X	X	X
5222	Rocklin	Sunset Blvd. @ Rt. 65 to Pacific St., 4-6 lane						
5223	Rocklin	Sierra College Blvd. @ Rocklin Rd. to Taylor Rd., 2/4-6 lanes	X	X			X	
5224	Rocklin	Sierra College Blvd. @ Douglas Blvd. to Rocklin Rd., 2/4-6 lanes	X	X	X		X	X
5225	Rocklin	Rocklin Rd. @ Pacific to I-80,2/4-6 lanes			X			
9200	West Sacramento	Jefferson Blvd. @ Gregory to I-80, 4-6 lanes	X	X	X	X	X	X

FIGURE 5.2 -- EVALUATION CRITERIA MATRIX

Evaluation Criteria[1]	1984 Conditions	Build only projects with currently assured funding - 2010 "Base"	Alternative 1 Transportation control measures, transit response Emphasis: Mandatory TCM's LRT extensions	Alternative 2 Roadway facility response, major new facilities Emphasis: Rts. 65/148 (freeway) connecting I-5, Rt. 99, Rt. 50 & I-80	Alternative 3 Roadway facility response, major new facilities Emphasis: Rt. 102, I-5 & 99 to I-80 @ Auburn	Alternative 4 Roadway facility response, major new facilities Emphasis: Both Rt. 102 and Rts. 65/148 (freeway)	Alternative 5 Roadway facilities response, expand existing system Emphasis: Roadway Widenings Rts. 65/148 (arterial)	Alternative 6 Roadway & transit facility response, major new facilities Emphasis: LRT extensions, Mandatory TCMS, Rt. 102, Rts. 65/148 (freeway)
Transportation System Characteristics:								
Lane Mile:								
Freeway	1,051	1,112	1,234	1,483	1,447	1,662	1,232	1,699
Major Arterials	1,476	1,872	2,094	2,070	2,164	2,127	2,268	2,150
LRT System Miles	0	18.3	63.2	48.8	48.8	48.8	48.8	63.2
Bus Line Miles	1,172	816	1,078	891	891	891	891	1,078
Weekday Statistics:								
Vehicle Miles Traveled	21,873,000	49,636,000	45,413,000	48,523,000	48,195,000	48,440,000	48,089,061	45,713,000
Total Transit Trips	39,430	94,130	228,100	114,100	114,100	114,100	114,100	228,000
Total Vehicle Trips	4,397,747	8,214,670	7,645,000	8,045,000	8,045,000	8,045,000	8,045,000	7,645,000
TCM Trip Reduction	[2]	[2]	663,960	221,300	221,300	221,300	221,300	663,960
Peak-Hour Statistics:								
Vehicle Hours of Delay	20,183	101,500	47,034	55,847	51,851	48,744	55,980	38,412
Lane Miles-LOS A-D								
Freeways	1,000	433	589	820	891	1147	588	1195
Major Arterials	1,205	1,154	1,626	1,544	1,642	1,636	1,724	1,662
Lane Miles-LOS E								
Freeways	31	107	189	178	114	130	150	192
Major Arterials	85	83	121	109	118	107	104	116
Lane Miles-LOS F								
Freeways	20	572	456	485	442	385	494	312
% Freeway Lane Miles	2%	52%	37%	33%	31%	23%	40%	18%
Major Arterials	186	635	347	417	404	385	440	300
% Maj. Art. Lane Mi.	13%	34%	17%	20%	19%	18%	19%	14%

[1]Definitions of the evaluation criteria are given on the previous page.
[2]Current level of TCM trip reduction is included in vehicle occupancy rates.

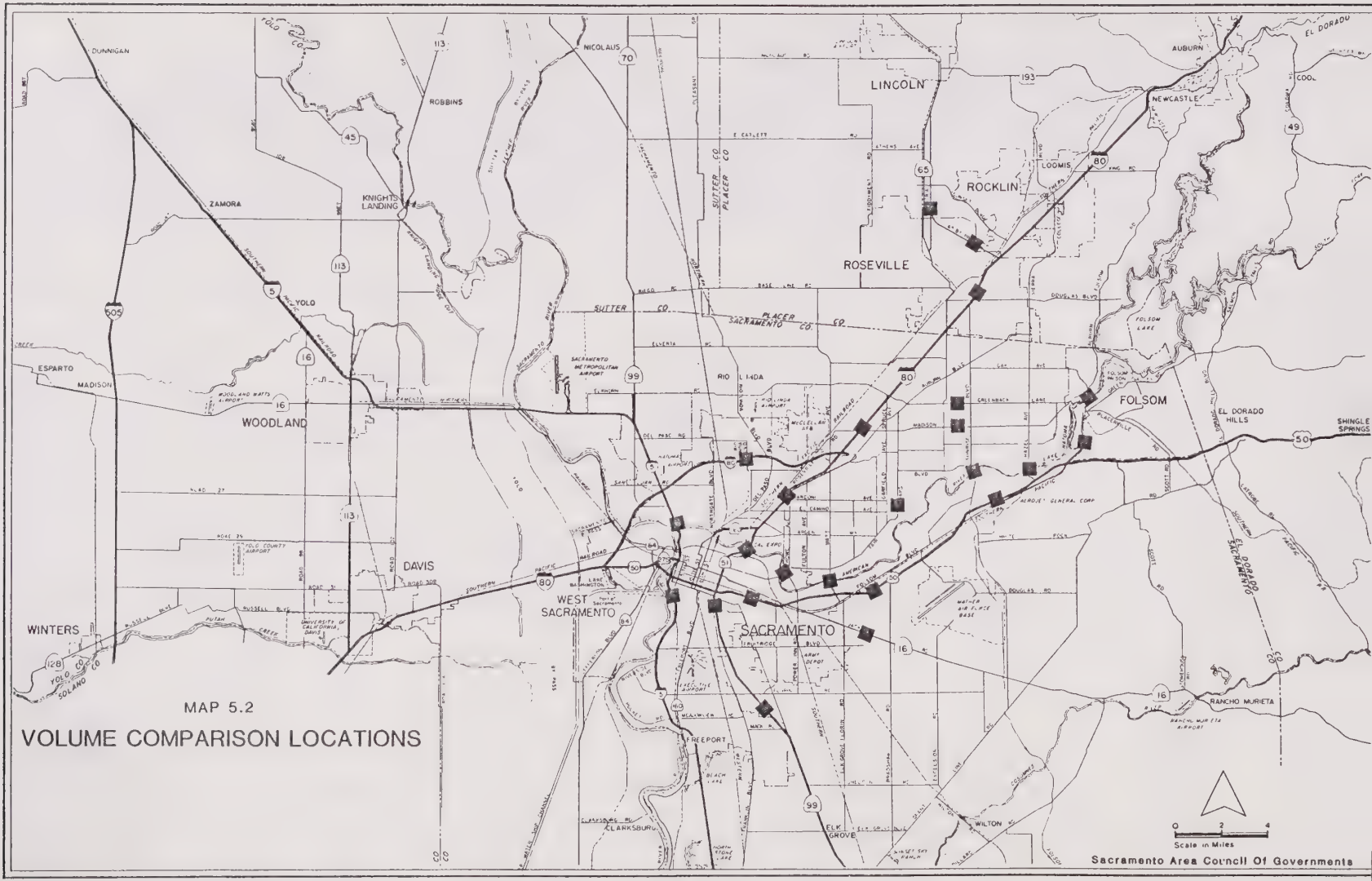
FIGURE 5.3 -- VOLUMES 1

Volume Count Location	1984 Conditions	Build only projects with currently assured funding - 2010 "Base"	Alternative 1 Transportation control measures, transit response Emphasis: Mandatory TCM's LRT extensions	Alternative 2 Roadway facility response, major new facilities Emphasis: Rts. 65/148 (freeway) connecting I-5, Rt. 99, Rt. 50 & I-80	Alternative 3 Roadway facility response, major new facilities Emphasis: Rt. 102, I-5 & 99 to I-80 @ Auburn	Alternative 4 Roadway facility response, major new facilities Emphasis: Both Rt. 102 and Rt. 65/148 (freeway)	Alternative 5 Roadway facilities response, expand existing system Emphasis: Roadway Widenings Rts. 65/148 (arterial)	Alternative 6 Roadway & transit facility response, major new facilitie Emphasis: LRT extensions, Mandatory TCMS, Rt. 102, Rts. 148 (freeway)
I-5								
No. of American River	61,193	214,130	167,016	181,117	200,523	202,355	182,683	174,109
So. of Rt. 50/Bus. 80	88,166	197,724	172,557	193,855	186,820	181,238	182,458	164,550
Route 99								
So. of Florin Road	54,673	99,756	135,941	139,662	144,356	137,562	141,192	137,280
So. of Rt. 50/Bus. 80	125,098	179,322	197,665	199,642	199,977	198,766	201,275	194,942
I-80								
So. of Madison Ave.	119,155	270,280	263,800	259,929	246,820	244,129	264,232	233,432
No. of Douglas Blvd.	79,847	172,046	176,230	158,563	160,130	156,260	178,908	158,283
Route 50								
W. of Power Inn Road	107,953	196,520	187,541	198,236	200,606	195,138	200,609	183,811
W. of Bradshaw Road	92,624	191,249	182,981	192,348	180,163	188,280	180,609	164,896
W. of Hazel Avenue	75,517	133,838	130,477	142,989	145,700	137,911	148,112	125,456
Business 80								
So. of Route 160	113,138	155,488	166,405	165,765	174,321	158,348	169,463	157,325
Route 16								
East of Florin Rd.	7,841	27,794	20,762	23,997	22,391	23,371	21,056	18,491
River Crossings								
Howe Avenue	48,622	76,258	49,570	56,411	46,639	54,754	45,765	40,497
Watt Avenue	53,022	77,814	96,014	95,684	80,977	96,181	80,704	80,630
Prop. 3rd Crossing	----	----	----	----	65,289	----	67,323	56,059
Sunrise Blvd.	55,175	107,769	90,695	89,644	91,009	86,622	90,412	79,141
Hazel Avenue	41,816	77,955	80,360	38,734	67,872	41,876	88,627	36,878
Rainbow Bridge	20,788	42,873	34,158	22,597	38,435	15,782	38,358	25,267
Folsom Blvd. - Folsom-Auburn Rd.	----	----	----	24,664	26,778	11,814	28,330	----
Oak Ave. Extension	----	----	----	----	33,402	31,886	33,959	29,608
Folsom Blvd. @ City of Folsom	11,256	25,306	29,159	38,162	35,967	38,335	38,040	37,139
Madison Ave. west of Sunrise	53,625	80,910	79,710	76,623	77,453	76,471	77,328	78,139
Greenback Ave. west of Sunrise	36,797	56,442	50,624	63,700	60,524	61,087	58,157	53,997

FIGURE 5.4

VOLUMES 2

Volume Count Location	1984 Conditions	Build only projects with currently assured funding - 2010 "Base"	Alternative 1 Transportation control measures, transit response Emphasis: Mandatory TCM's LRT extensions	Alternative 2 Roadway facility response, major new facilities Emphasis: Rts. 65/148 (freeway) connecting I-5, Rt. 99, Rt. 50 & I-80	Alternative 3 Roadway facility response, major new facilities Emphasis: Rt. 102, I-5 & 99 to I-80 @ Auburn	Alternative 4 Roadway facility response, major new facilities Emphasis: Both Rt. 102 and Rts. 65/148 (freeway)	Alternative 5 Roadway facilities response, expand existing system Emphasis: Roadway Widenings Rts. 65/148 (arterial)	Alternative 6 Roadway & transit facility response, major new facilities Emphasis: LRT extensions, Mandatory TCMS, Rt. 102, Rts. 65/148 (freeway)
oute 102								
West of Watt Avenue	----	----	----	----	44,553	41,973	----	36,683
West of Route 65	----	----	----	----	37,263	34,586	----	31,452
T 65/148 (freeway)								
I-80 - Folsom	----	----	----	70,421	----	69,499	----	65,458
Folsom - Rt. 50	----	----	----	67,233	----	62,466	----	55,992
Rt. 50 - Rt. 16	----	----	----	34,762	----	33,253	----	28,243
Rt. 16 - Calvine	----	----	----	28,548	----	27,447	----	25,385
Rt. 99 - I-5	----	----	----	16,342	----	15,673	----	14,750
T 65/148 (arterial)								
I-80 - Folsom-Auburn Road	----	----	----	----	----	----	26,485	----
Folsom-Auburn Rd.	8,270	20,697	15,301	6,406	14,698	5,061	19,057	4,288
South of Route 50	785	9,759	8,416	6,922	8,682	6,899	10,007	6,526
Grant Line Road (Sheldon-Elk Grove)	1,705	21,172	14,122	4,343	16,085	4,361	17,056	4,213



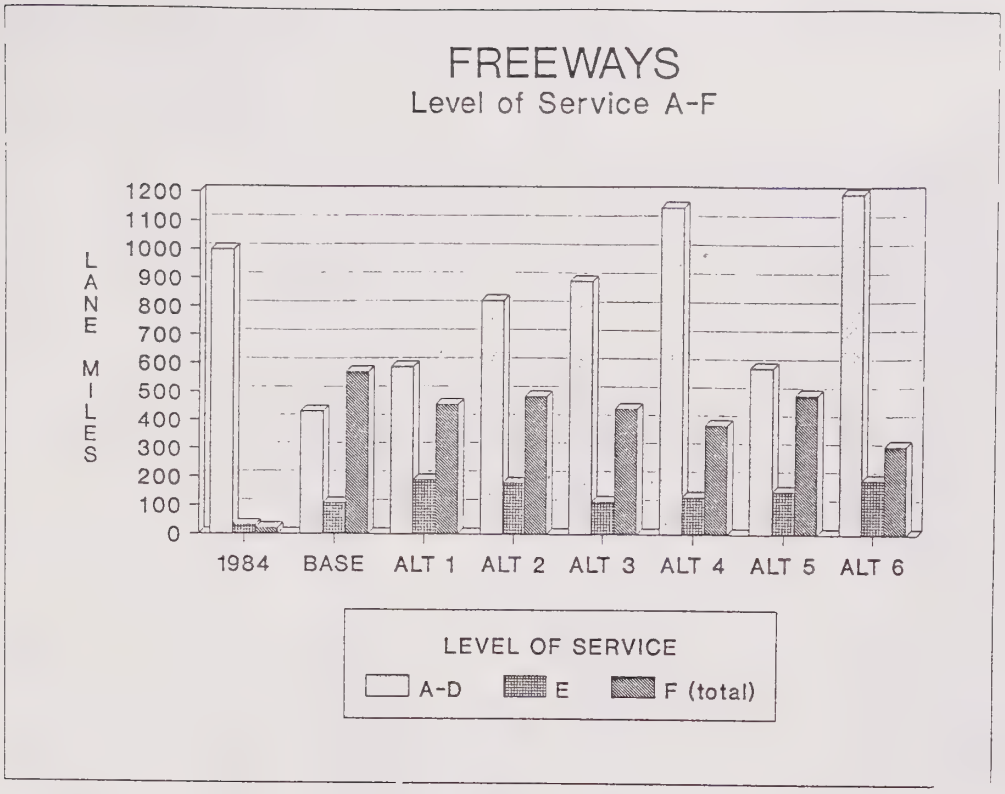
MAP 5.2

VOLUME COMPARISON LOCATIONS

FIGURE 5.5

COST ESTIMATES ($ '000s)

Project Type	Alternative 1 Transportation control measures, transit response Emphasis: Mandatory TCM's LRT extensions	Alternative 2 Roadway facility response, major new facilities Emphasis: Rts. 65/148 (freeway) connecting I-5, Rt. 99, Rt. 50 & I-80	Alternative 3 Roadway facility response, major new facilities Emphasis: Rt. 102, I-5 & 99 to I-80 @ Auburn	Alternative 4 Roadway facility response, major new facilities Emphasis: Both Rt. 102 and Rts. 65/148 (freeway)	Alternative 5 Roadway facilities response, expand existing system Emphasis: Roadway Widenings Rts. 65/148 (arterial)	Alternative 6 Roadway & transit facility response, major new facilities Emphasis: LRT extensions, Mandatory TCMS, Rt. 102, Rts. 65/148 (freeway)
Roadway						
New Facilities	112,035	884,477	465,954	1,207,158	196,000	1,215,022
Freeway & hwy. Widenings	207,400	207,400	207,400	207,400	207,400	207,400
Surface Street Widenings	184,340	188,453	218,862	192,013	201,791	179,748
Subtotal	**503,775**	**1,280,330**	**892,216**	**1,606,571**	**605,191**	**1,602,170**
Transit						
Capital	723,806	426,596	426,596	426,596	426,596	723,806
TOTAL COST	**1,227,581**	**1,706,926**	**1,318,812**	**2,033,167**	**1,031,787**	**2,325,976**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1100
1000
900
800
700
600
500
400
300
200
100
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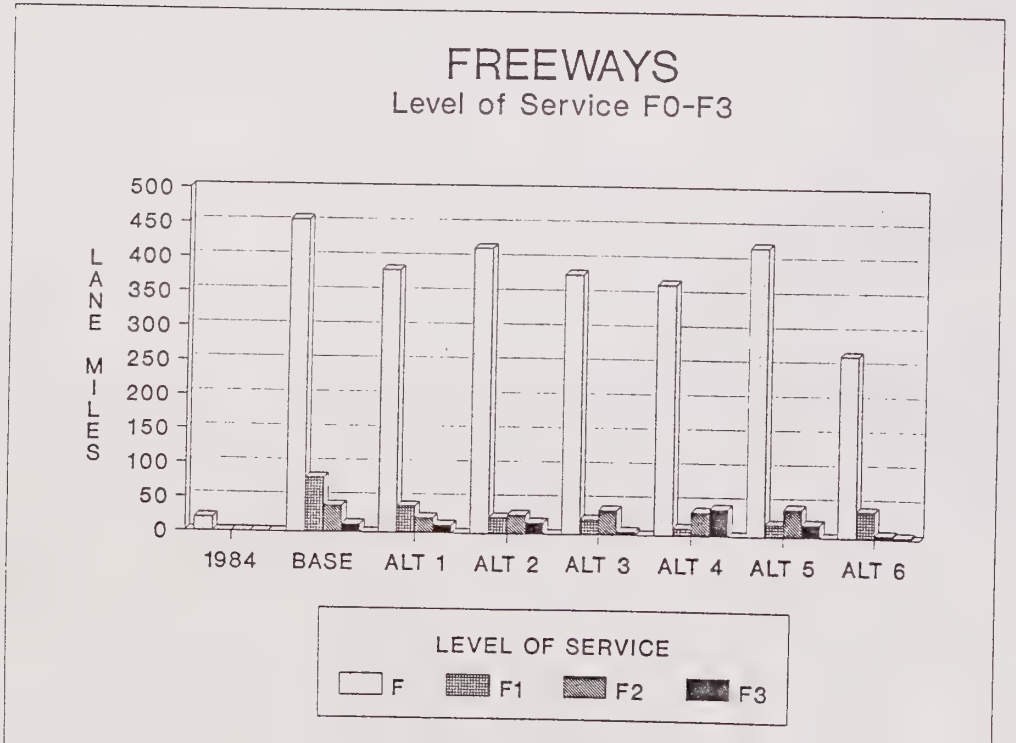
1984
BASE
ALT 1
ALT 2
ALT 3
ALT 4
ALT 5
ALT 6
LEVEL OF SERVICE
A-D
E
F (total)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50
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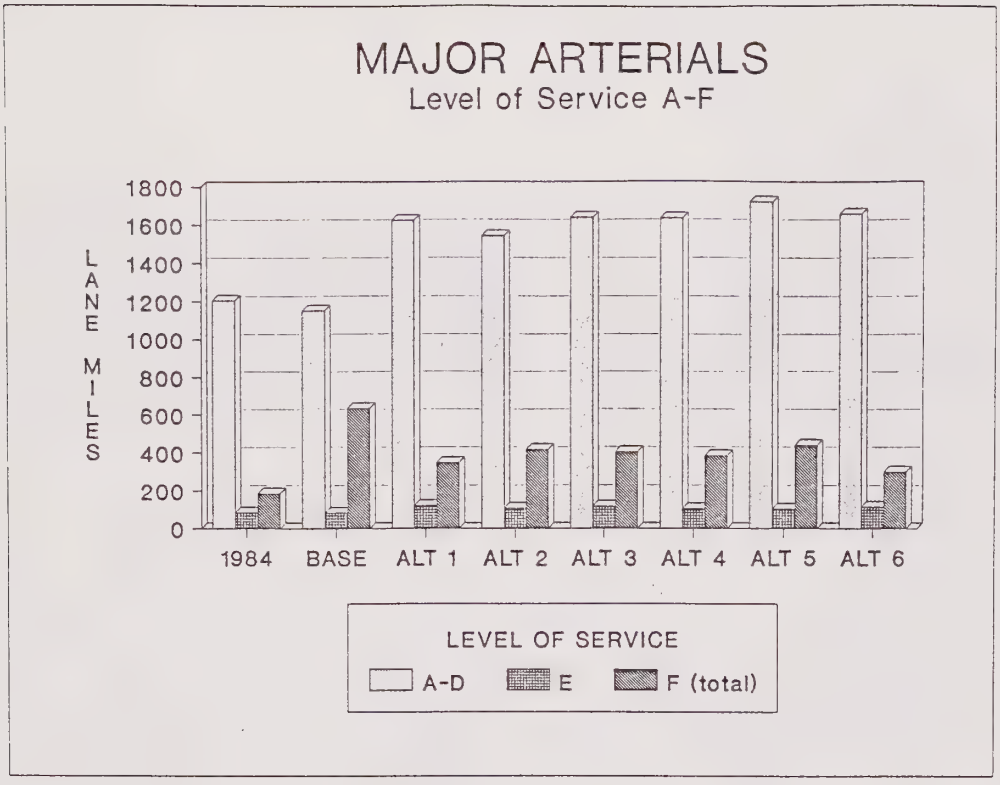
ALT 3
ALT 4
ALT 5
ALT 6
LEVEL OF SERVICE
F
F1
F2
F3

FIGURE 5.6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1400
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1000
800
600
400
200
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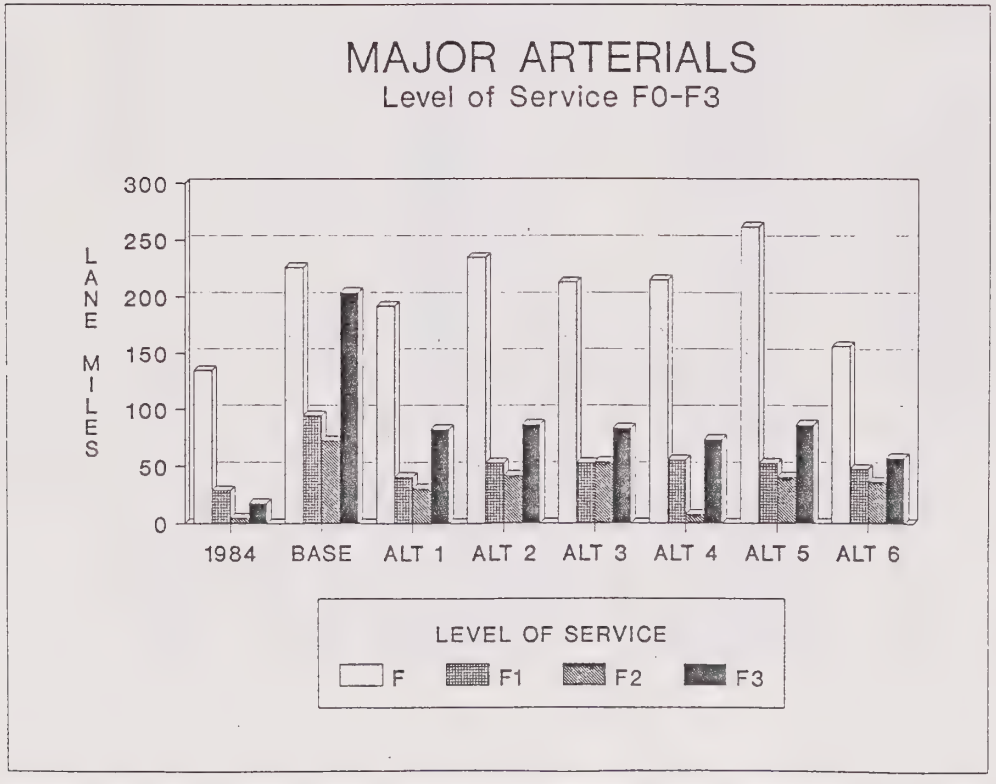
BASE
ALT 1
ALT 2
ALT 3
ALT 4
ALT 5
ALT 6
LEVEL OF SERVICE
A-D
E
F (total)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Level of Service F0-F3
LANE MILES
300
250
200
150
100
50
0
1984
BASE
ALT 1
ALT 2
ALT 3
ALT 4
ALT 5
ALT 6
LEVEL OF SERVICE
F
F1
F2
F3

FIGURE 5.7

BASE 2010 NETWORK

Emphasis: Currently Programmed and Funded Roadway Improvements

Transit Improvements

There are no light rail extensions planned in the base 2010 network beyond those currently in place. The existing LRT system will be double-tracked, however. There will be no bus expansions in the base; and in fact, bus line miles are assumed to drop as the LRT system is double-tracked.

Roadway System Improvements

Roadway improvements that will be implemented in the 2010 base network include only those projects that are currently programmed and funded. This includes many roadway widenings and improvements, but none of the major new projects included in the alternatives are in the base network. Projects in the base network include: widenings on Route 99 and I-5, and on Sunrise, Watt, Hazel, and other major surface streets.

Transportation Control Measures

No transportation control measures are anticipated for 2010 in the base network.

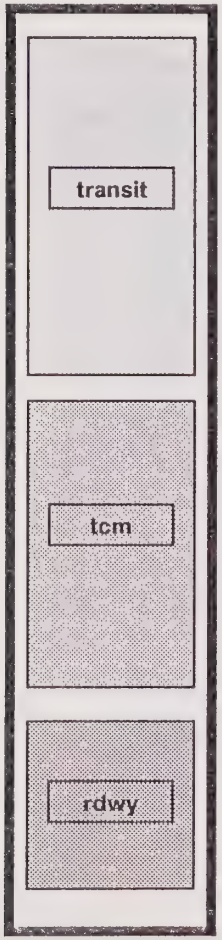
Advantages

None.

Disadvantages

This network leaves the Sacramento area transportation system in complete gridlock. This system creates over 49 million vehicle miles traveled, which results in over 100,000 vehicle hours of delay in the peak hour. It results in 752 freeway miles (52 percent) at LOS F; 34 percent of major arterials are at LOS F.

Metro Study
Strategy Emphasis



ALTERNATIVE ONE

Transit and Transportation Control Measures
(With Roadway Projects)

Expansion of light rail to Antelope at I-80, Hazel at Rt. 50, south to Meadowview/Calvine, north to North Natomas, and west to West Sacramento. Extend bus service to Roseville, Laguna, North Natomas, Vineyard, Antelope, Rancho Cordova, and other growth areas

Mandatory TCM programs including parking management, staggered work hours, carpools/vanpools, and other measures resulting in:

- **15% decrease in peak-period traffic causing a 6% reduction in average daily traffic.**

Freeway, major arterial widenings, and new facilities from projects proposed by local jurisdictions and Caltrans; other facilities as necessary to meet designated levels of service.

ALTERNATIVE ONE ANALYSIS

Emphasis:
Transit and Transportation Control Measures

Transit Improvements

This alternative relies primarily on transit improvements. It is similar to the Sacramento Regional Transit District's 20-year outlook (as illustrated on Map 5.3). It includes light rail extensions to Antelope Road in the I-80 corridor, to Hazel Avenue in the Route 50 corridor, to Meadowview and Calvine Roads in the south, and to North Natomas and West Sacramento. Bus service is also expanded to the LRT growth areas as well as to Roseville and other outlying areas.

Roadway System Improvements

While the major emphasis of Alternative One is transit and TCMs, it also includes many new and improved roadway facilities. These include an extension of Truxel Road across the American River and widening of I-80 from I-5 to Watt, as well as many surface street widenings and improvements. Map 5.4 illustrates some of the larger projects included in this alternative.

Transportation Control Measures

In this alternative it is assumed that successful, mandatory TCM ordinances have been implemented. These programs would include employer-sponsored car and vanpools, parking management, flex hours, and other measures. The measures are assumed to reduce vehicle trips in the peak hour by 15 percent.

Advantages

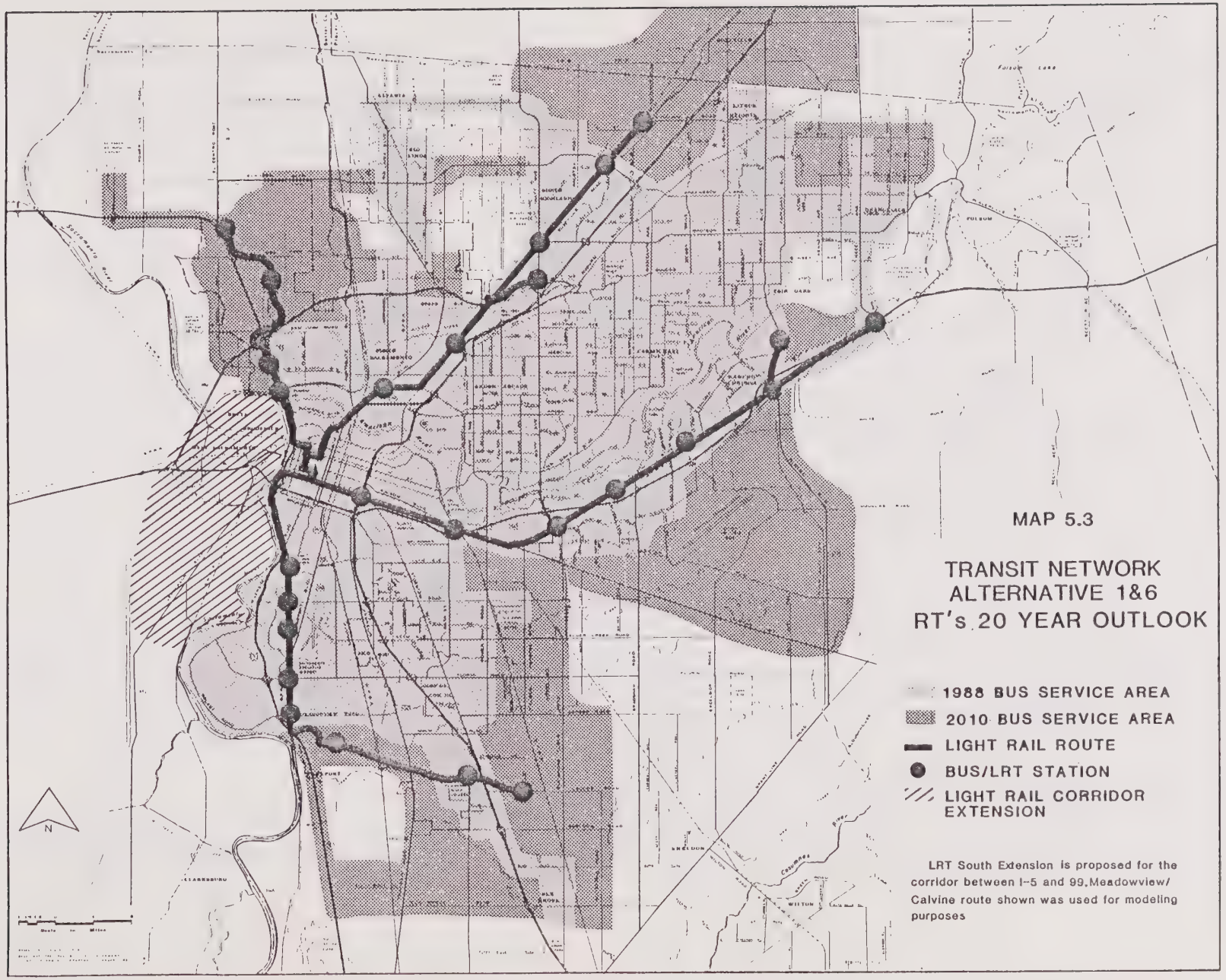
This alternative emphasizes transit and transportation control measures. As a result, the primary advantage is a lowering of vehicle miles traveled and hours of delay. Vehicle miles traveled (VMT) decreases by 8.5 percent from the base 2010 network. Vehicle hours of delay decreases by 54 percent from the 2010 base.

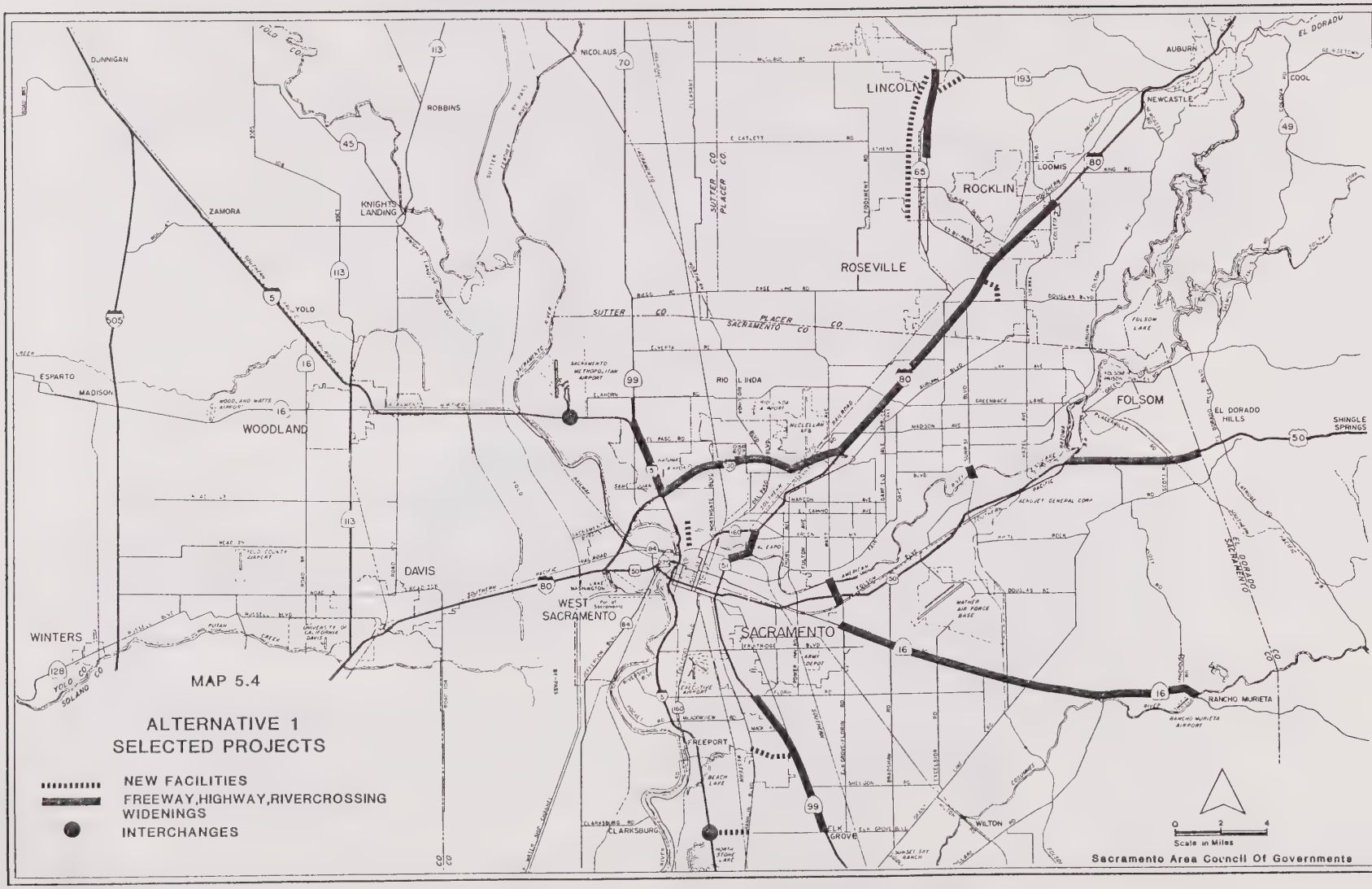
This alternative also has one of the lowest number of freeway miles of any of the alternatives (1,234) and one of the highest transit miles (1,078 bus line miles and 48.8 LRT miles). Additionally, transit trips increases from 94,130 in the base to 228,100.

The cost of this alternative is $1.3 billion; however, this does not include the unknown cost of implementing such a comprehensive TCM program.

Disadvantages

One of the greatest disadvantages of this alternative is the extent to which the reductions rely on successful implementation of transportation control measures. The actual reductions that could be achieved and the cost are unknown at this time. This alternative also still leaves a great deal of level of service F on the highways. See Map 5.5.


MAP 5.3
TRANSIT NETWORK
ALTERNATIVE 1&6
RT's 20 YEAR OUTLOOK
1988 BUS SERVICE AREA
2010 BUS SERVICE AREA
LIGHT RAIL ROUTE
BUS/LRT STATION
LIGHT RAIL CORRIDOR EXTENSION
LRT South Extension is proposed for the corridor between I-5 and 99. Meadowview/ Calvine route shown was used for modeling purposes
N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ESPARTO
MADISON
RIO LINDA
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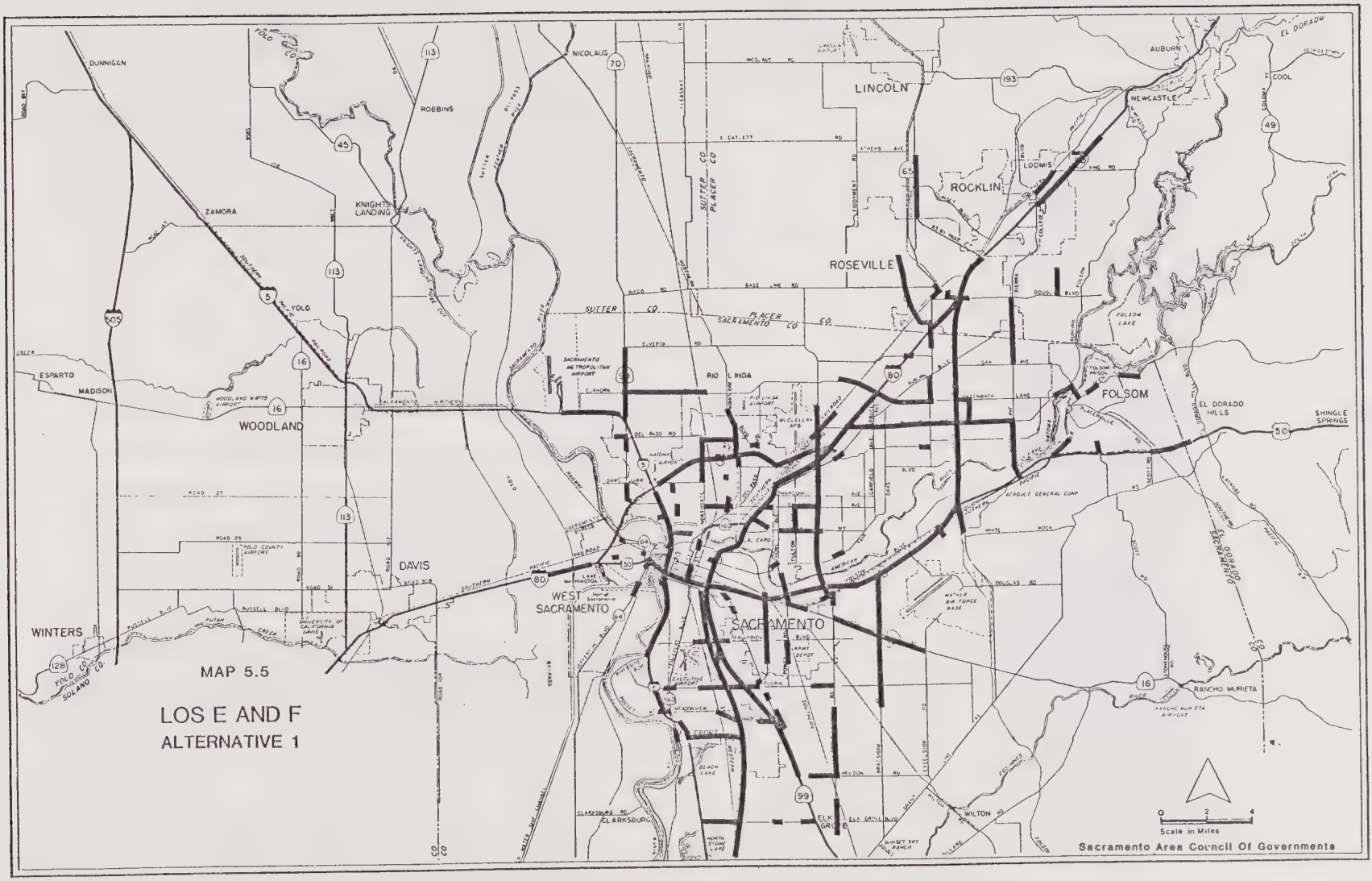
EL DORADO HILLS
SHINGLE SPRINGS
WOODLAND
DAVIS
WEST SACRAMENTO
SACRAMENTO
WINTERS
RANCHO MURIETA
FREEPORT
CLARKSBURG
ELK GROVE
WILTON
MAP 5.4
ALTERNATIVE 1
SELECTED PROJECTS
NEW FACILITIES
FREEWAY, HIGHWAY, RIVERCROSSING WIDENINGS
INTERCHANGES
0 2 4
Scale in Miles
Sacramento Area Council Of Governments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SHINGLE SPRINGS
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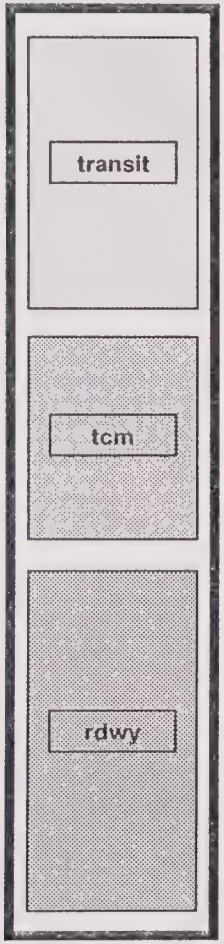
SACRAMENTO
WINTERS
SOLANO CO.
RANCHO MURIETA
CLARKSBURG
ELK GROVE
WILTON
MAP 5.5
LOS E AND F
ALTERNATIVE 1
Scale in Miles
Sacramento Area Council Of Governments

Metro Study
Strategy Emphasis



ALTERNATIVE TWO

Roadway Facility Expansion
(With Route 65/148 Freeway)

Expansion of light rail to Antelope at I-80, Hazel at Rt. 50, and south to Meadowview/Calvine. Extend bus service to North Natomas and other growth areas.

Voluntary TCM measures including carpool/vanpools, flexible work schedules, and other measures resulting in:

5% decrease in peak-period traffic causing a 2% reduction in average daily traffic.

Inclusion of a freeway facility extending from I-80 near Roseville to Rt. 50 near Folsom to Rt. 99 and I-5 near Elk Grove; widening of current freeways and roadways; addition of bridge crossings; and other projects necessary to bring the transportation system to LOS E.

ALTERNATIVE TWO ANALYSIS

Emphasis: Roadway Facility Expansion (Route 65/148 Freeway)

Transit Improvements

Alternative Two includes many transit improvements although not as comprehensive as those in Alternative One (see Map 5.6). Light rail extensions to Antelope Road on the I-80 corridor, to Hazel on the Route 50 corridor, and to Meadowview and Calvine Roads are all included.

Roadway System Improvements

Alternative Two emphasizes roadway improvements with the focus being the Route 65/148 freeway. This is a new facility which would connect I-5 and Route 99 near Elk Grove to I-80 near Folsom to Route 50 near Roseville. Other major projects in the alternative include an American River Bridge at Folsom/Auburn Road and widenings throughout the region. Map 5.7 illustrates some of the more significant projects included in this alternative.

Transportation Control Measures

This alternative involves voluntary TCM measures as opposed to the mandatory measures in Alternative One. The alternative assumes moderate compliance success for carpool, flex hour, parking management, and other TCM measures, which are assumed to reduce vehicle trips in the peak hour by 5 percent.

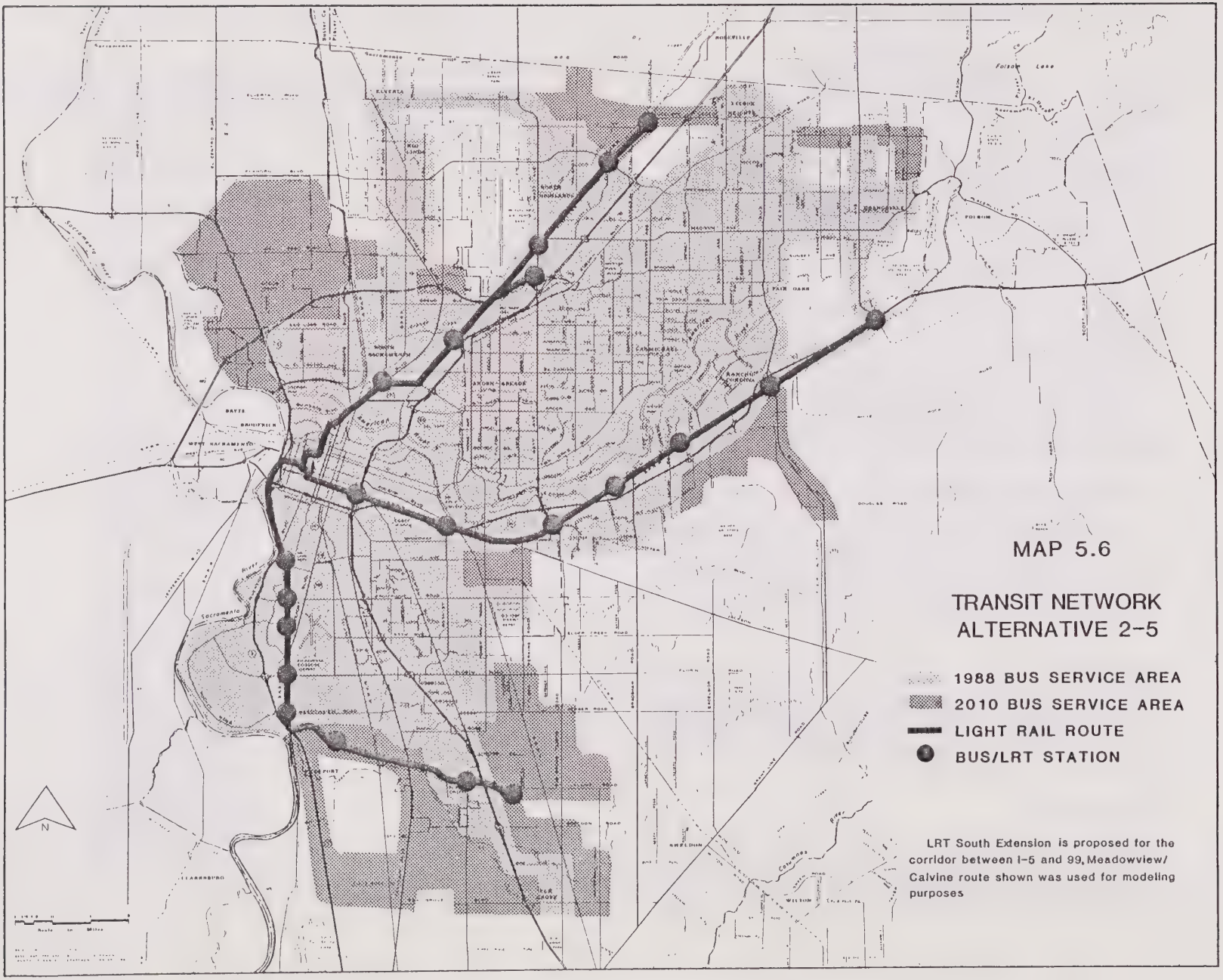
Advantages

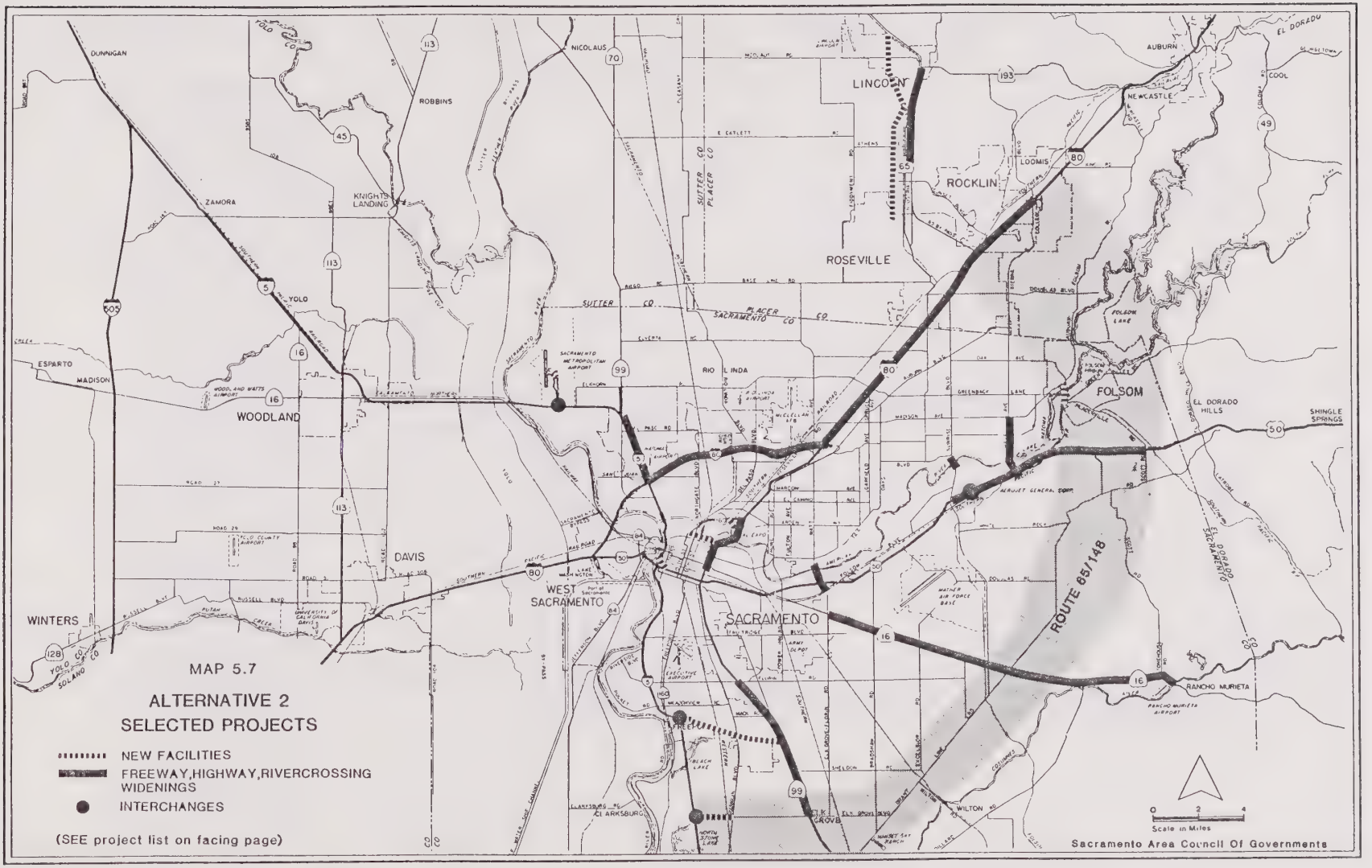
This alternative provides some congestion relief through increased transit and TCMs. It also provides a more direct route between the growing areas of south Placer County and South Sacramento, Elk Grove.

Disadvantages

This alternative does not significantly relieve many of the congestion problems in the Sacramento area. Vehicle miles traveled is only reduced by 2 percent from the base network. Vehicle hours of delay is reduced by only 45 percent from the 2010 base year. This is the lowest of the six alternatives. Also 485 freeway miles stay at LOS F. See Map 5.8.

This alternative could also encourage growth along the corridor created by the Route 65/148 freeway resulting in more traffic pressures. Local opposition along the route of this proposed freeway could also be a disadvantage.


MAP 5.6
TRANSIT NETWORK
ALTERNATIVE 2-5
1988 BUS SERVICE AREA
2010 BUS SERVICE AREA
LIGHT RAIL ROUTE
BUS/LRT STATION
N
LRT South Extension is proposed for the corridor between I-5 and 99, Meadowview/ Calvine route shown was used for modeling purposes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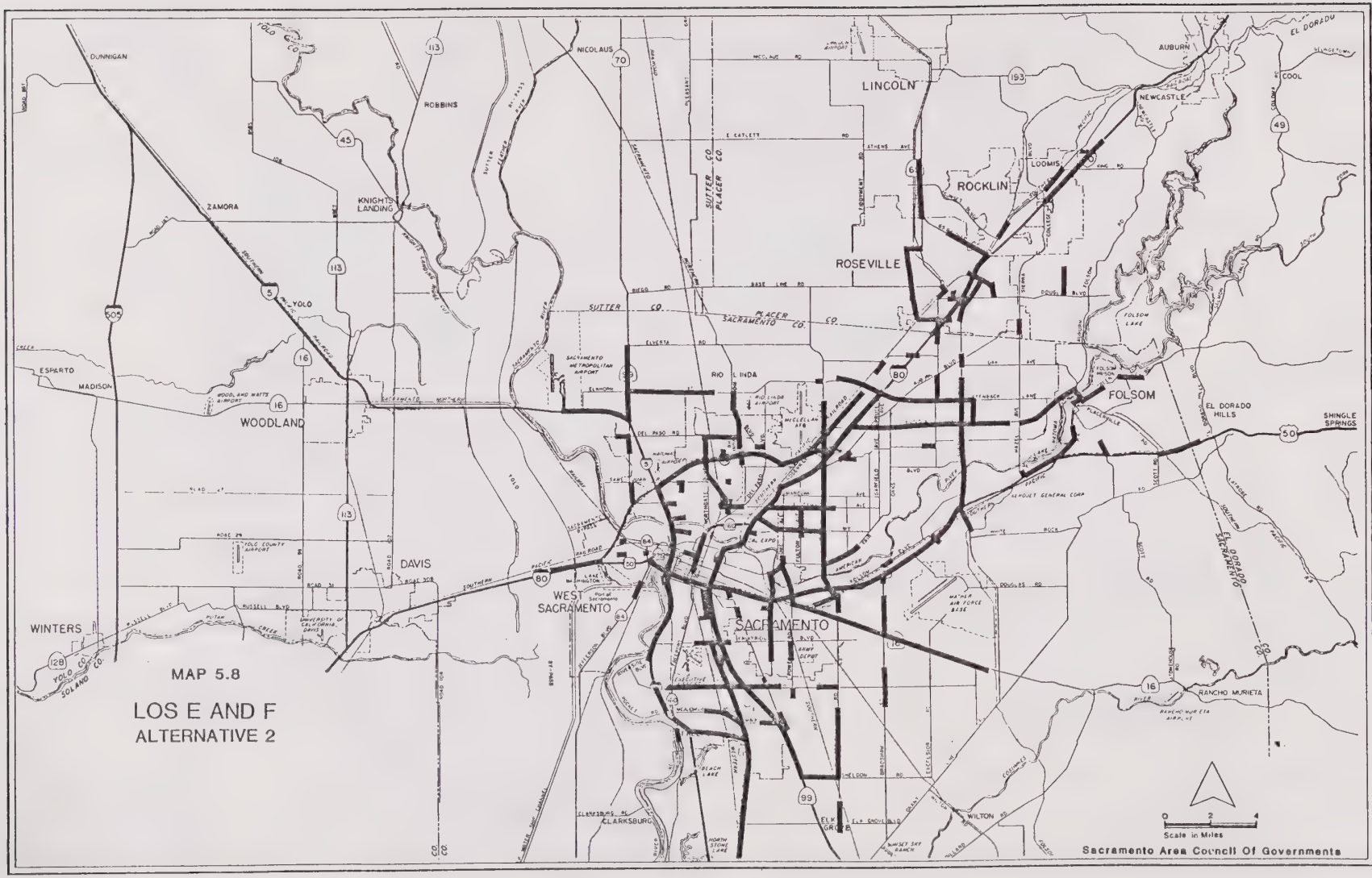
AUBURN
NEWCASTLE
LOOMIS
RIO LINDA
FOLSOM
EL DORADO HILLS
SHINGLE SPRINGS
RANCHO MURIETA
ROUTE 65/148
CLARKSBURG
WILTON
GALT
SUTTER CO
PLACER CO
SACRAMENTO CO
YOLO CO
SOLANO CO
EL DORADO CO
MAP 5.7
ALTERNATIVE 2
SELECTED PROJECTS
NEW FACILITIES
FREEWAY, HIGHWAY, RIVERCROSSING WIDENINGS
INTERCHANGES
(SEE project list on facing page)
0 2 4
Scale in Miles
Sacramento Area Council Of Governments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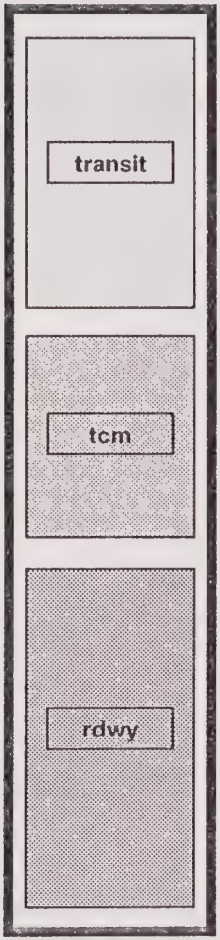
DAVIS
WEST SACRAMENTO
SACRAMENTO
WINTERS
RANCHO MURIETA
CLARKSBURG
ELK GROVE
WILTON
MAP 5.8
LOS E AND F
ALTERNATIVE 2
Scale in Miles
Sacramento Area Council Of Governments

Metro Study
Strategy Emphasis



ALTERNATIVE THREE

Roadway Facility Expansion
(With Route 102)

transit

Expansion of light rail to Antelope at I-80, Hazel at Rt. 50, and south to Meadowview/Calvine. Extend bus service to North Natomas and other growth areas.

tcm

Voluntary TCM measures including carpool/vanpools, flexible work schedules, and other measures resulting in:

5% decrease in peak-period traffic causing a 2% reduction in average daily traffic.

rdwy

Inclusion of Rt. 102 extending from Rt. 99 at I-5 to Auburn near Bell Avenue; widening of current freeways and roadways; addition of bridge crossings; and other projects necessary to bring the transportation system to LOS E.

ALTERNATIVE THREE ANALYSIS
Emphasis: Roadway Facility Expansion (Route 102 Freeway)

Transit Improvements

Transit improvements in Alternative Three are exactly the same as those in Alternative Two (see Map 5.6). It includes LRT extensions to Antelope Road on Interstate 80, to Hazel Avenue on Route 50, and to Meadowview and Calvine Roads in the south area. The existing bus system is modified to serve the LRT extensions. These improvements will be the same for Alternatives Four and Five as well.

Roadway System Improvements

Alternative Three emphasizes roadway construction and improvement with the focus being the construction of Route 102. Route 102 would be a new facility north of and parallel to I-80. This would connect I-5 with I-80 near Auburn. Map 5.9 illustrates significant projects included in this alternative.

Transportation Control Measures

As with the transit improvements, the TCM measures implemented in Alternative Three are exactly the same as those in Alternative Two. These are continued in Alternatives Four and Five as well. This calls for voluntary TCM measures in each jurisdiction and assumes moderate compliance and success.

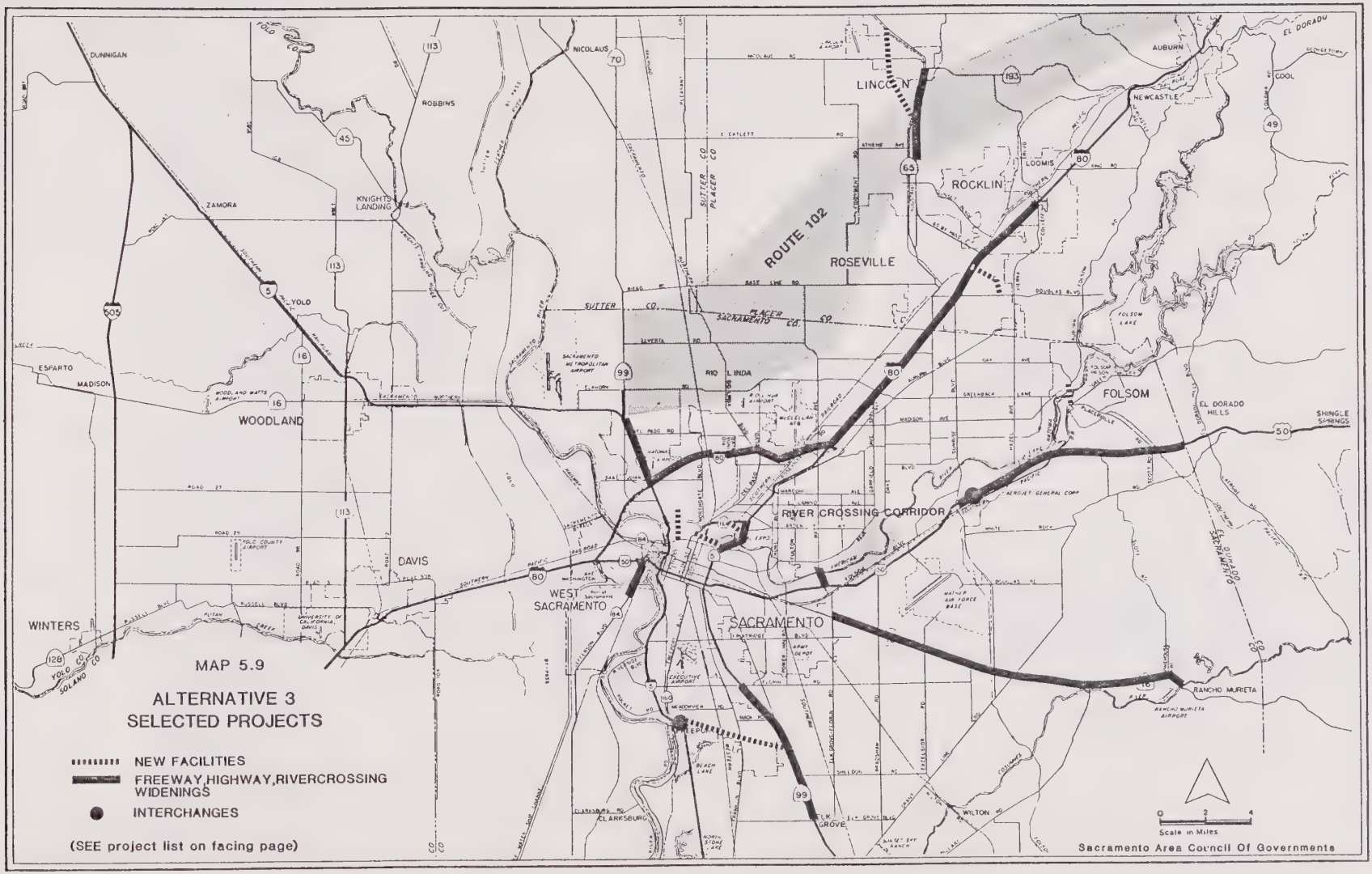
Advantages

This alternative provides an alternative parallel facility to relieve the growing congestion on I-80. This alternative does a fairly good job of reducing level of service F (see Map 5.10) and does provide some additional relief through LRT and bus line expansions. This alternative is relatively inexpensive at $1.3 billion.

Disadvantages

As with the Route 65/148 freeway alternative, this alternative could encourage growth along the newly-created corridor and thus add to traffic pressures.

Vehicle miles traveled decreases by only 2 percent from the 2010 base and vehicle hours of delay decreases by only 49 percent. Both of these are well below other alternatives analyzed.

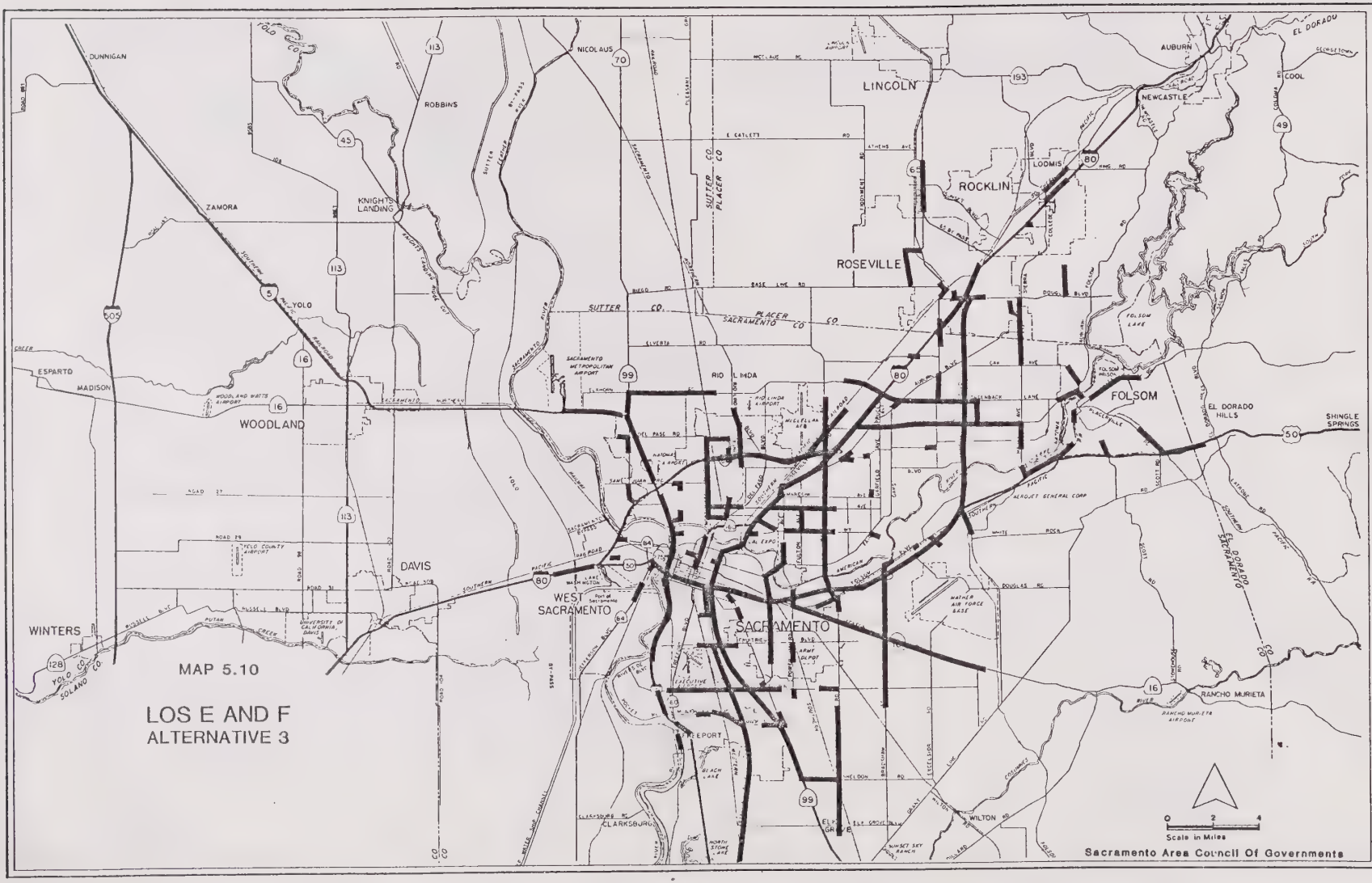


MAP 5.9

ALTERNATIVE 3
SELECTED PROJECTS

- NEW FACILITIES
- FREEWAY, HIGHWAY, RIVERCROSSING WIDENINGS
- INTERCHANGES

(SEE project list on facing page)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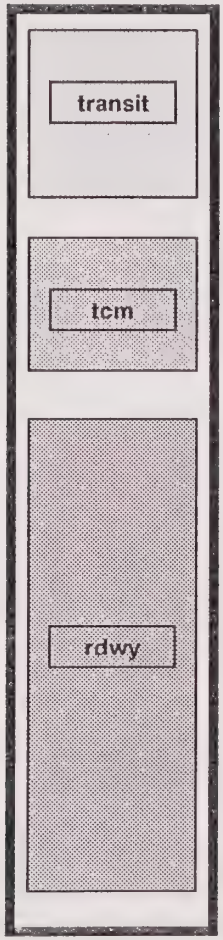
SUTTER CO
PLACER CO
ROSEVILLE
YOLO
SUTTER CO
PLACER CO
SACRAMENTO CO
ESPARTO
MADISON
WOODLAND
SACRAMENTO METROPOLITAN AIRPORT
RIO LINDA
FOLSOM
EL DORADO HILLS
SHINGLE SPRINGS
DAVIS
WEST SACRAMENTO
SACRAMENTO
WINTERS
MAP 5.10
LOS E AND F
ALTERNATIVE 3
YOLO CO
SOLANO CO
RANCHO MURIETA
CLARKSBURG
WILTON
0 2 4
Scale in Miles
Sacramento Area Council Of Governments

Metro Study
Strategy Emphasis



ALTERNATIVE FOUR

Roadway Facility Expansion
(With Route 65/148 Freeway and Route 102)

Expansion of light rail to Antelope at I-80, Hazel at Rt. 50, and south to Meadowview/Calvine. Extend bus service to North Natomas and other growth areas.

Voluntary TCM measures including carpool/vanpools, flexible work schedules, and other measures resulting in:

5% decrease in peak-period traffic causing a 2% reduction in average daily traffic.

Inclusion of Rt. 102 extending from Rt. 99 at I-5 to Auburn near Bell Avenue; Rt. 65/148 freeway extending from I-80 near Roseville to Rt. 50 near Folsom to Rt. 99 and I-5 near Elk Grove; widening of current freeways and roadways; addition of bridge crossings; and other projects necessary to bring the transportation system to LOS E.

ALTERNATIVE FOUR ANALYSIS

Emphasis:
Roadway Facility Expansion
(Route 102 and Route 65/148)

Transit Improvements

Alternatives Two through Five include light rail extensions along I-80 to Antelope Road, along Route 50 to Hazel, and south to Meadowview and Calvine (see Map 5.6). The bus system is modified to serve the LRT extensions.

Roadway System Improvements

Alternative Four emphasizes roadway improvements and construction with the focus being the addition of Routes 102 and 65/148. See Map 5.11 for an illustration of significant projects included in this alternative.

Transportation Control Measures

Alternatives Two through Five call for voluntary TCM measures and assume a moderate compliance and success rate. The programs would include measures such as car and vanpools, parking management, and flex hours.

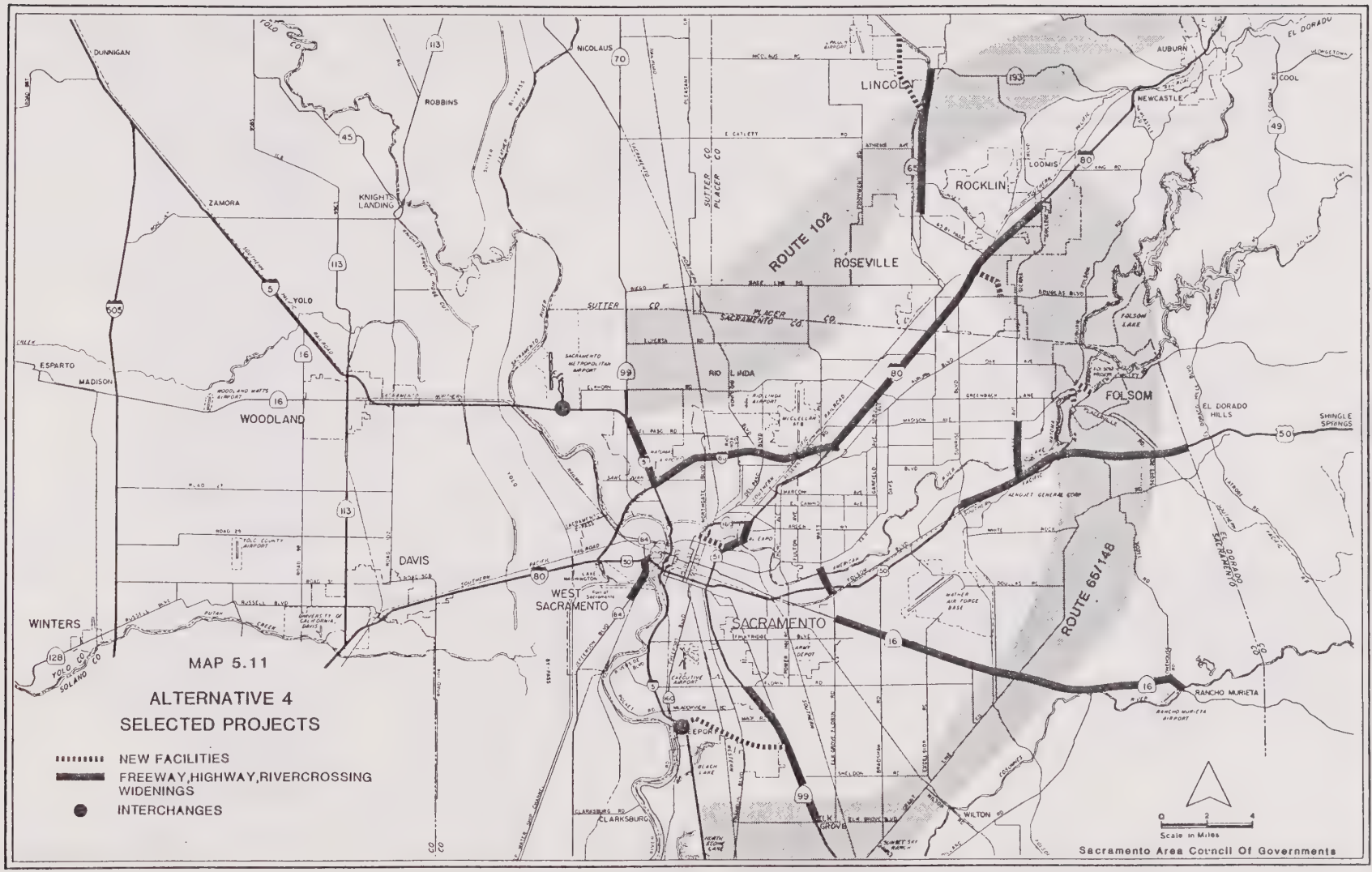
Advantages

This alternative provides two facilities which can be used to route trips around the very congested downtown freeway area. This is evidenced by the fact that vehicle hours of delay are reduced by 52 percent from the 2010 base and LOS F is only 23 percent of all freeway miles. See Map 5.12.

Disadvantages

While these two new facilities help to relieve some congestion, they have some drawbacks as well. This alternative has the second highest number of freeway lane miles at 1,662. This then results in only a 2 percent decrease in vehicle miles traveled from the base 2010 year. As with Alternatives Two and Three, right-of-way and local opposition could make implementation of these new facilities difficult.

The cost of this alternative is $2 billion. This is relatively high among the six alternatives.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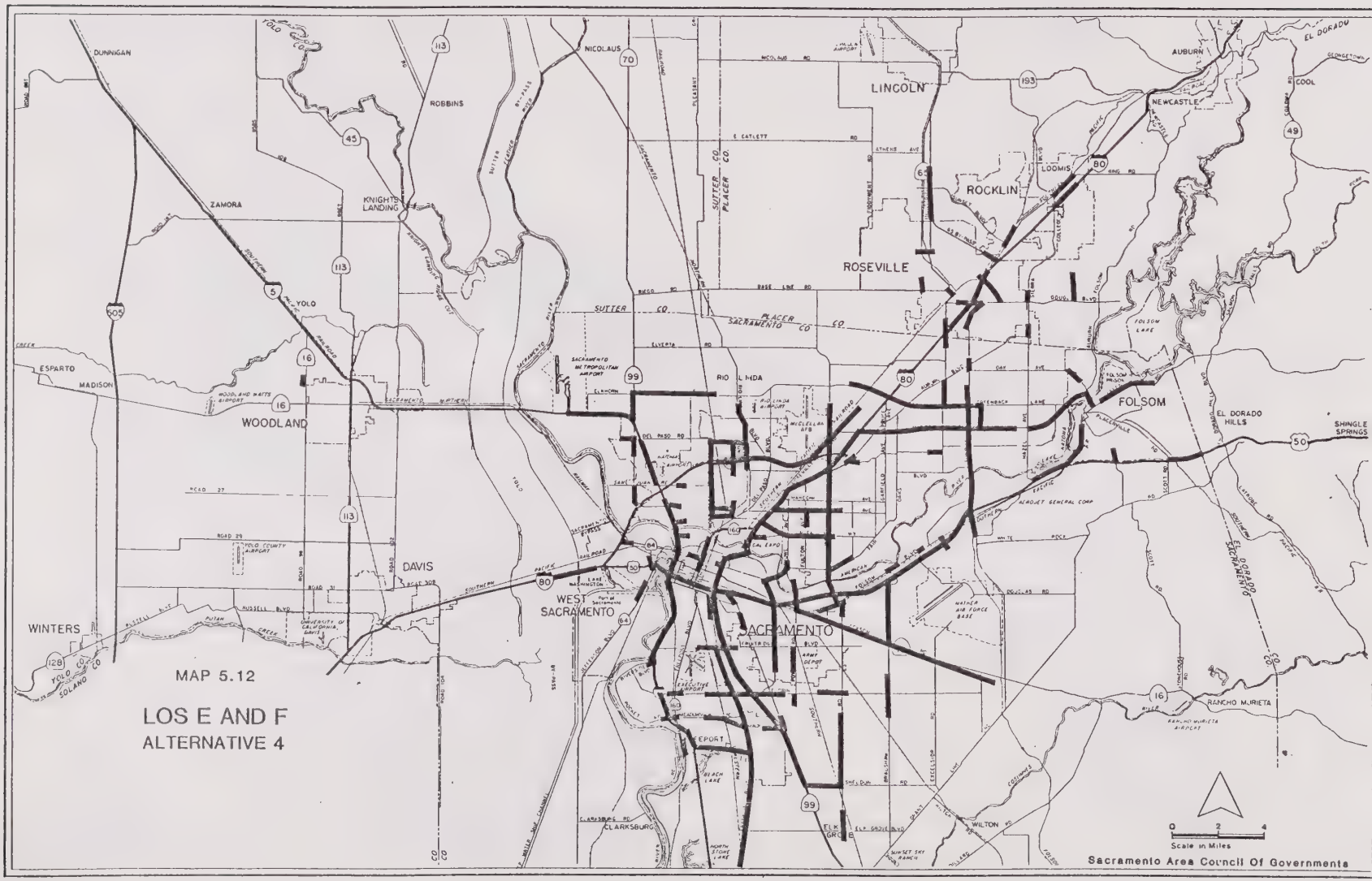
NEWCASTLE
ROCKLIN
LOOMIS
ROSEVILLE
ROUTE 102
FOLSOM
EL DORADO HILLS
SHINGLE SPRINGS
ROUTE 65/148
RANCHO MURIETA
WILTON
CLARKSBURG
ELK GROVE
MAP 5.11
ALTERNATIVE 4
SELECTED PROJECTS
NEW FACILITIES
FREEWAY, HIGHWAY, RIVERCROSSING WIDENINGS
INTERCHANGES
Scale in Miles
Sacramento Area Council Of Governments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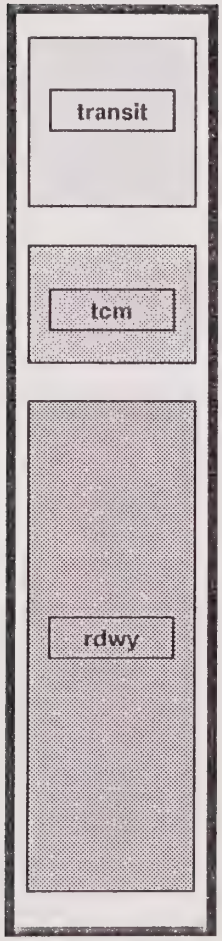
WINTERS
RANCHO MURIETA
CLARKSBURG
WILTON
MAP 5.12
LOS E AND F
ALTERNATIVE 4
0 2 4
Scale in Miles
Sacramento Area Council Of Governments

Metro Study
Strategy Emphasis



ALTERNATIVE FIVE

Roadway Facility Expansion
(Existing Facilities and River Crossings)

Expansion of light rail to Antelope at I-80, Hazel at Rt. 50, and south to Meadowview/Calvine. Extend bus service to North Natomas and other growth areas.

Voluntary TCM measures including carpool/vanpools, flexible work schedules, and other measures resulting in:

5% decrease in peak-period traffic causing a 2% reduction in average daily traffic.

Inclusion of freeway and roadway widenings; construction of new roadways, construction of river crossings; and other projects necessary to bring the transportation system to LOS E. Does not include any new regional freeway projects, and looks at roadway projects before transit or TCM projects.

ALTERNATIVE FIVE ANALYSIS

Emphasis:
Roadway Facility Expansion
(Existing Facilities and River Crossings)

Transit Improvements

Alternatives Two through Five include light rail extensions along I-80 to Antelope Road, along Route 50 to Hazel, and south to Meadowview and Calvine. The bus system is modified to serve the LRT extensions.

Roadway System Improvements

The emphasis of Alternative Five is to improve the system through facility improvements and widenings without building new major freeway facilities. Many widening projects were included in this alternative as well as a number of new facilities such as a new American River crossing between Watt and Sunrise and an extension of Truxel across the American River to downtown. Map 5.13 illustrates significant projects in this alternative.

Transportation Control Measures

Alternatives Two through Five include voluntary TCM measures to be developed and implemented by each jurisdiction. These could include car and vanpools, parking management, and flex hours. This alternative assumes moderate compliance and success of these TCM measures.

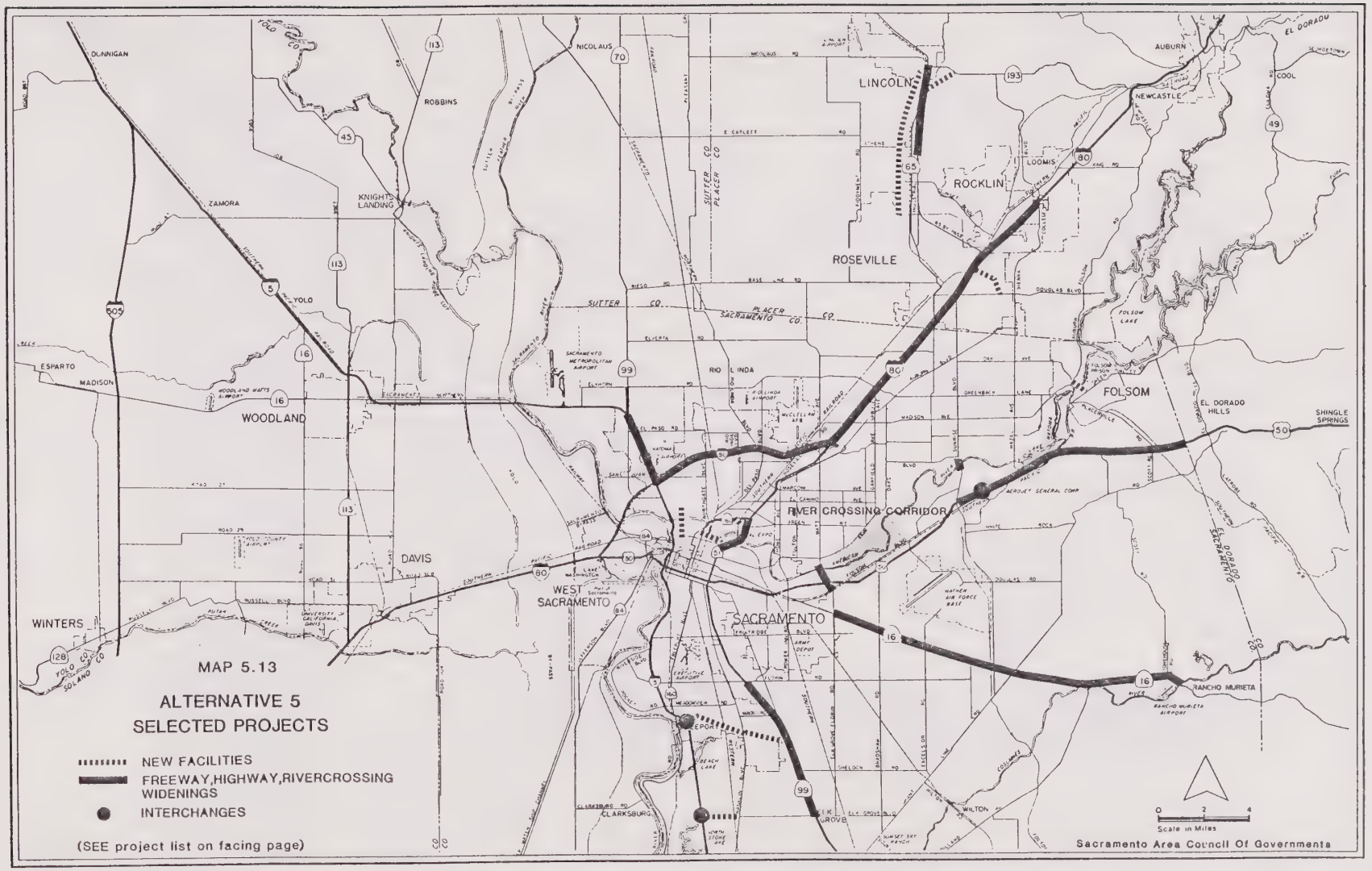
Advantages

This alternative focuses on projects that add to the existing system. This results in less growth inducement and does not create extensive right-of-way problems. Alternative Five has the fewest number of freeway miles at 1,232. This alternative is the least expensive of the six alternatives at $1 billion.

Disadvantages

Alternative Five actually does very little to relieve congestion in the Sacramento region. While the system does improve over the 2010 base network, in many areas this alternative is the weakest of the six alternatives. See Map 5.14.

Vehicle miles traveled decreases only 2 percent from the base 2010 network. Vehicle hours of delay decrease by only 45 percent, and 494 freeway miles remain at LOS F. At selected locations on the network, Alternative Five shows less of a volume decrease than in any other alternative. Out of 19 locations, 10 are not estimated to be lower than the 2010 base.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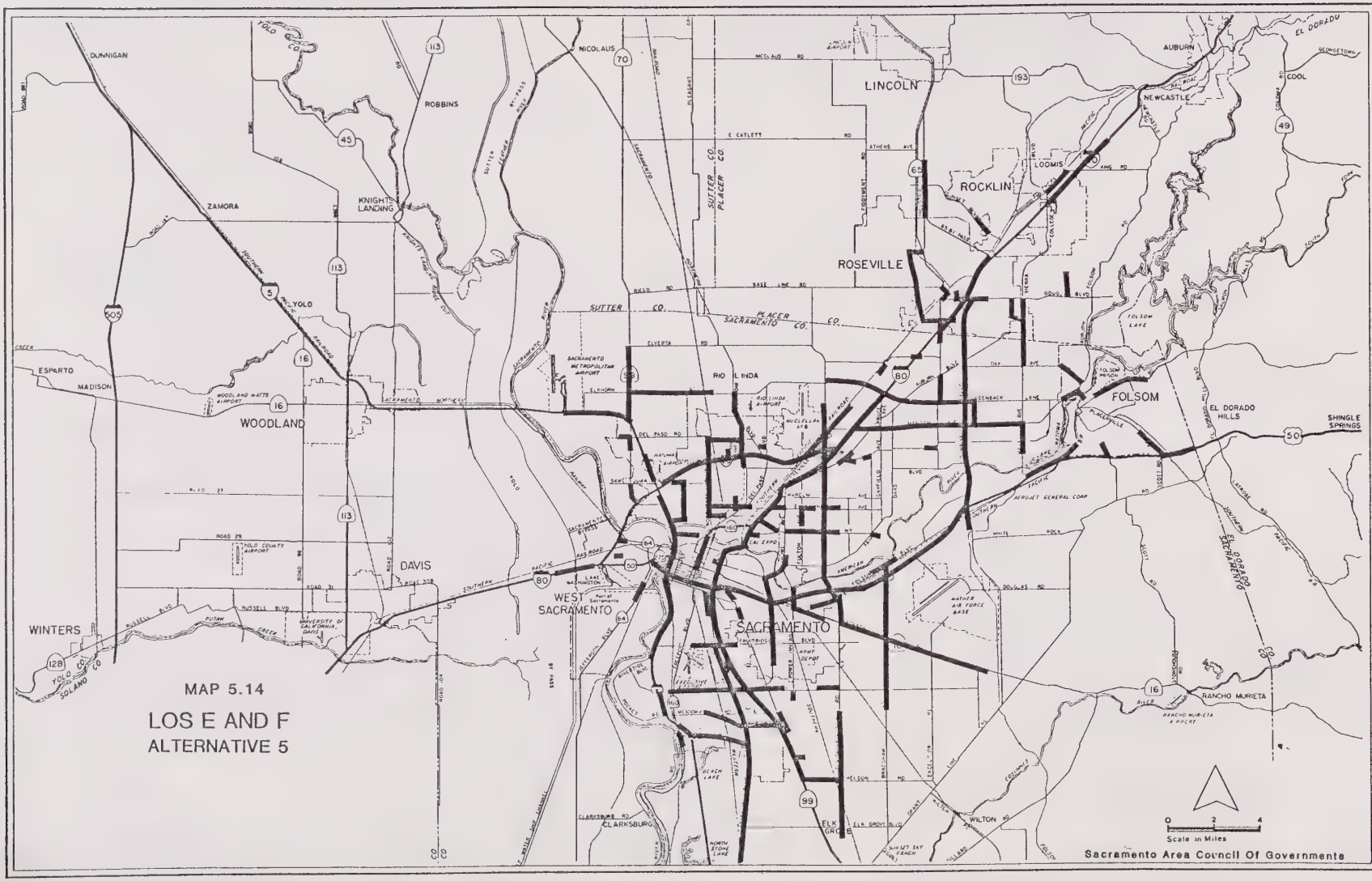
EL DORADO HILLS
SHINGLE SPRINGS
RANCHO MURIETA
CLARKSBURG
ELK GROVE
WILTON
RIVER CROSSING CORRIDOR
SUTTER CO.
PLACER CO.
YOLO CO.
SOLANO CO.
EL DORADO CO.
SACRAMENTO CO.
MAP 5.13
ALTERNATIVE 5
SELECTED PROJECTS
NEW FACILITIES
FREEWAY,HIGHWAY,RIVERCROSSING WIDENINGS
INTERCHANGES
(SEE project list on facing page)
Scale in Miles
Sacramento Area Council Of Governments

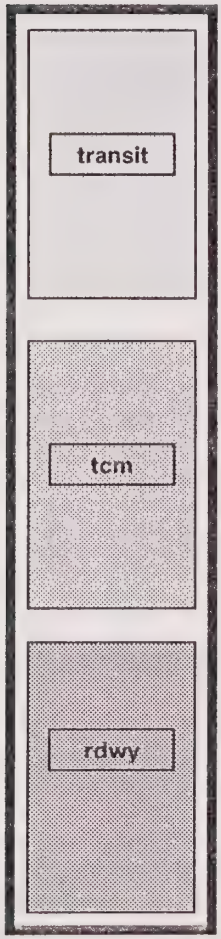


MAP 5.14

LOS E AND F

ALTERNATIVE 5

Metro Study
Strategy Emphasis



ALTERNATIVE SIX

Transit, Roadway Facility Expansion and Roadway Widening Emphasis

Expansion of light rail to Antelope at I-80, Hazel at Rt. 50, south to Meadowview/Calvine, north to North Natomas, and west to West Sacramento. Extend bus service to Roseville, Laguna, North Natomas, Vineyard, Antelope, Rancho Cordova, and other growth areas.

Mandatory TCM measures including carpool/vanpools, flexible work schedules, and other measures resulting in:

- 15% decrease in peak-period traffic causing a 6% reduction in average daily traffic.

Inclusion of Rt. 102 extending from Rt. 99 at I-5 to Auburn near Bell Avenue; Rt. 65/148 freeway extending from I-80 near Roseville to Rt. 50 near Folsom to Rt. 99 and I-5 near Elk Grove; widening of existing freeways and roadways; addition of bridge crossings; and other projects necessary to bring the transportation system to LOS E.

ALTERNATIVE SIX ANALYSIS

Emphasis:
Transit, TCMs, Route 102, Route 65/148

Transit Improvements

Alternative Six includes the same transit improvements as were included in Alternative One (see Map 5.3). These improvements include extension of light rail to Antelope on the I-80 line, to Hazel on the Route 50 line, as well as to Meadowview and Calvine Roads in the south, North Natomas, and West Sacramento. This alternative also includes the bus line expansions to Roseville to support the light rail extensions.

Roadway System Improvements

Alternative Six includes the roadway projects that were included in Alternative Four. That is, the construction of Route 102 and of the Route 65/148 freeway. This alternative also includes many roadway widenings and a number of new bridge crossings as well. Map 5.15 illustrates significant projects on this list.

Transportation Control Measures

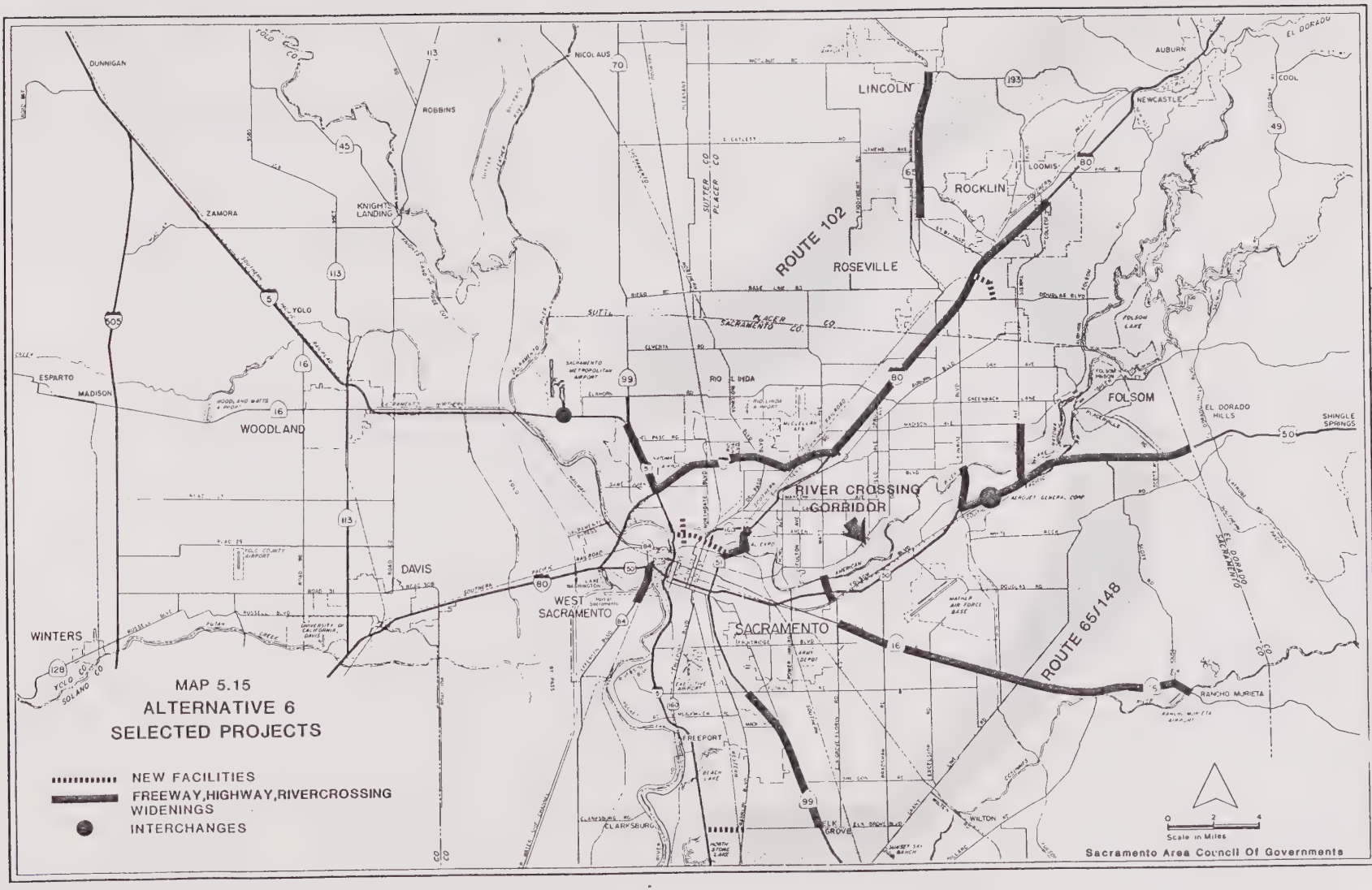
The same assumptions for mandatory TCM measures included in Alternative One are included in Alternative Six. This results in a 15 percent reduction of peak hour trips.

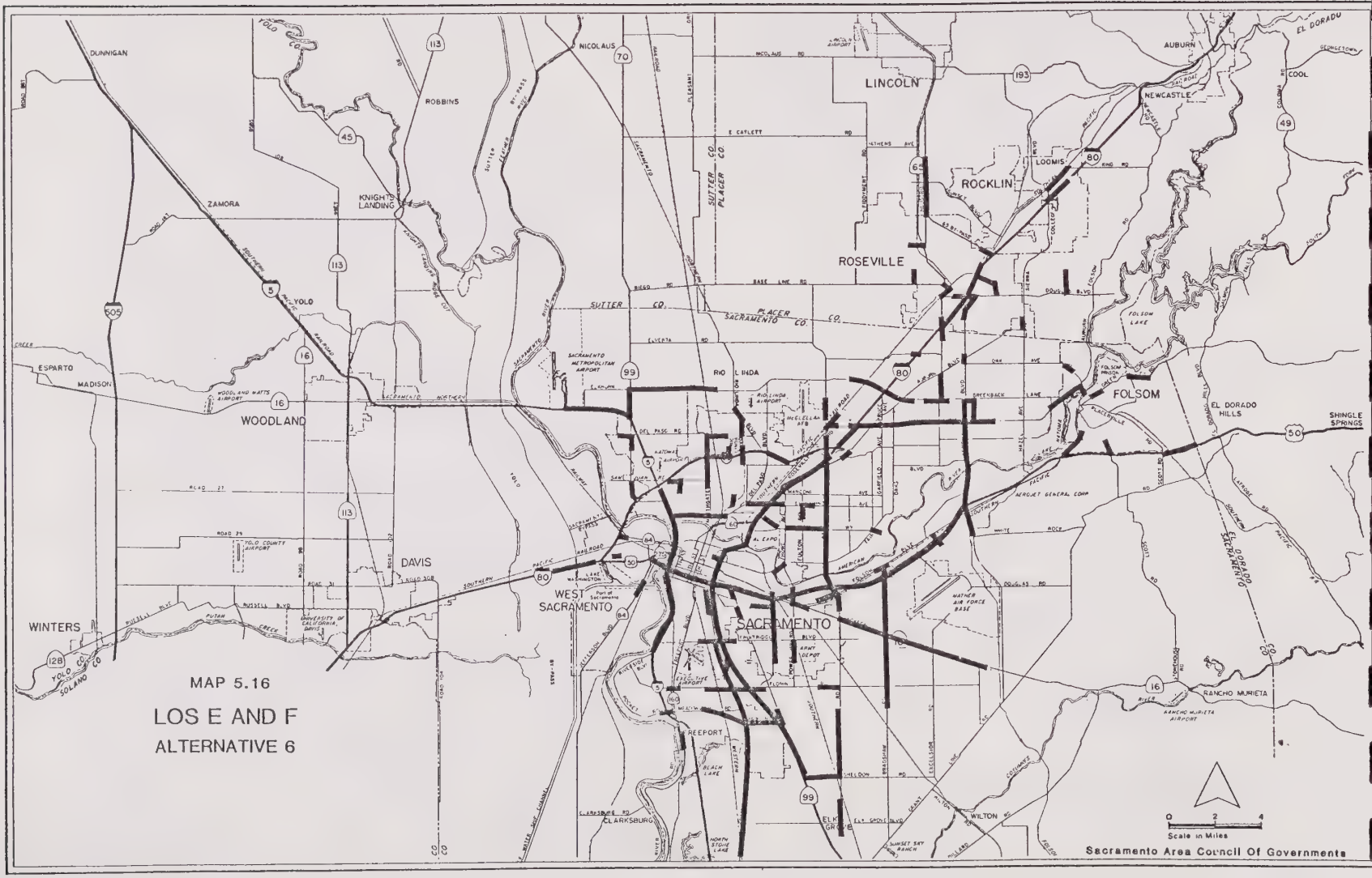
Advantages

As this is the most comprehensive improvement alternative, it has many advantages. Vehicle miles traveled decreases by 8.5 percent from the 2010 base network. This is very similar to the reduction for Alternative One. Also, as with Alternative One, transit trips are increased from 94,130 in the base to 228,100. This is double the number of transit riders in Alternatives Two through Five. Vehicle hours of delay decrease by 62 percent from the base network. This is a very significant decrease and is the best of any alternative. This alternative also has the fewest number of freeway lane miles at LOS F (see Map 5.16). Marked decreases in volumes are found on most sections of freeway and river crossings.

Disadvantages

While this is an extremely good alternative in improving traffic in the Sacramento area, it is not without drawbacks. Perhaps the most glaring of these is the cost. Alternative Six costs $2.3 billion and is substantially more expensive than the other alternatives. This alternative also increases freeway miles, the most of any alternative. Some of the potential problems associated with Alternative Four also apply here. Right-of-way and local opposition could make the new freeways difficult to construct.


DUNNIGAN
NICOLAUS
ROBBINS
LINCOLN
AUBURN
NEWCASTLE
COOL
ROCKLIN
LOOMIS
ROUTE 102
ROSEVILLE
ZAMORA
KNIGHTS LANDING
ESPARTO
MADISON
WOODLAND
RIO LINDA
FOLSOM
EL DORADO HILLS
SHINGLE SPRINGS
RIVER CROSSING CORRIDOR
DAVIS
WEST SACRAMENTO
SACRAMENTO
ROUTE 65/148
WINTERS
FREEPORT
CLARKSBURG
ELK GROVE
RANCHO MURIETA
MAP 5.15
ALTERNATIVE 6
SELECTED PROJECTS
NEW FACILITIES
FREEWAY, HIGHWAY, RIVERCROSSING WIDENINGS
INTERCHANGES
Scale in Miles
Sacramento Area Council Of Governments


DUNNIGAN
ZAMORA
KNIGHTS LANDING
ROBBINS
NICOLAUS
LINCOLN
AUBURN
NEWCASTLE
LOOMIS
ROCKLIN
ROSEVILLE
ESPARTO
MADISON
WOODLAND
DAVIS
WINTERS
WEST SACRAMENTO
SACRAMENTO
RIO LINDA
FOLSOM
EL DORADO HILLS
SHINGLE SPRINGS
RANCHO MURIETA
REEPORT
CLARKSBURG
ELK GROVE
WILTON
YOLO
SUTTER CO.
PLACER CO.
SACRAMENTO CO.
EL DORADO CO.
YOLO CO.
SOLANO CO.
MAP 5.16
LOS E AND F
ALTERNATIVE 6
0 2 4
Scale in Miles
Sacramento Area Council Of Governments

CHAPTER VI. LAND USE DEMONSTRATION SCENARIOS

PURPOSE

Traffic growth is usually associated with the increase in land use activities. It is logical to believe that significant changes in land use development patterns have a substantial impact on the demand for transportation facilities. The Metro Study attempted to illustrate this view by developing three hypothetical land use development scenarios. The purpose was not to draw a regional land use plan, but to illustrate the impacts that changing land use patterns could have on traffic congestion.

DEVELOPMENT

The study developed three land use scenarios with nodes of development in varying sizes for the year 2010. These scenarios were analyzed and compared to the 2010 Base. As with transportation Alternatives One and Six, the land use scenarios include expansion of light rail to Antelope Road in the I-80 corridor, Hazel Avenue in the Route 50 corridor, south to Meadowview/Calvine Roads, north to North Natomas, and west to West Sacramento. A 15 percent decrease in peak period traffic is also assumed, attributable to transportation control measures. No new freeway facilities were added; only improvements to local surface streets and highways were included in the scenarios.

Each development node was assumed to have a jobs-housing balance. It was also assumed that changes in land uses can only be influenced after 1995. The analysis used the socioeconomic data developed by SACOG's Research Section in determining the regionwide increases in population, housing, and employment from 1995 to 2010. The study made separate estimates of the distribution of population, housing, and employment for each of the three land use scenarios.

The land use estimates were made on the basis of the following:

1. Each node has a population density of 20,000 persons per square mile.

2. Household size in multiple-family dwelling units is 2.1 persons/household. Sixty percent of new population would live in multiple-family dwelling units.

3. Household size in single-family attached dwelling units is 2.5 persons per household. Twenty percent of new population will live in single-family attached dwelling units.

4. Household size in single-family detached dwelling units is 3.2 persons per household. Twenty percent of population will live in single-family detached dwelling units.

5. For each node, the ratio of housing units to regionwide housing total is equal to the ratio of employment to regionwide employment total. This is to provide a jobs-housing balance. The inclusion of retail employment serves to provide a mixed-use environment, allowing more shopping and personal business trips to be made close to home or work.

At no time did the location of these nodes take into account available vacant lands or other logical constraints on development. The node locations were selected for illustration purposes only.

The computation of traffic demand used the new sets of land use projections, but followed the same process described in Chapter IV.

RESULTS

The chief conclusion drawn from this hypothetical exercise is that different land use development patterns create different needs on the system. The analysis, however, includes the generous assumption that 100 percent of post-1995 growth will be redirected to higher density, mixed-use nodes. Results, shown in ranges in Figure 6.1, show the extent of impacts caused by different types of changes in land use patterns. It is interesting to note that with almost every criterion, the land use development scenarios show more promising results than those of the six alternatives discussed in Chapter V, but that land use development patterns can also be altered to worsen the projections made for 2010.

ANALYSIS

Emphasis: Alternative Development Patterns, Transit, and Transportation Control Measures

Transit Improvements

The three land use development scenarios consider all transit improvements discussed in the Sacramento Regional Transit District's 20-year Outlook (see Map 5.3). These include light rail extensions to Antelope Road in the I-80 corridor, Hazel Avenue in the Route 50 corridor, Meadowview and Calvine Roads in the south, North Natomas, and West Sacramento. The same transit improvements are included in Alternatives One and Six.

Roadway System Improvements

No new freeway facilities were added to the existing system. Only improvements to local surface streets and freeway widenings were included in the scenarios.

Transportation Control Measures

The same transportation control measures assumed in Alternatives One and Six were considered in the analysis of land use development scenarios. It is assumed that the TCMs would reduce vehicle trips in the peak hour by 15 percent.

Advantages

The three land use scenarios have an advantage over the six alternatives in terms of the reduction in vehicle miles traveled and total vehicle trips (see Figure 6.1). The land use scenarios show a 12 to 19 percent reduction in vehicle miles traveled compared with the 2010 base network. The highest VMT shown for the land use scenarios is lower than the VMT in Alternates One through Six.

Vehicle hours of delay decreases by 44 to 64 percent from the base 2010 network which is better than or comparable with any of the six alternatives.

Disadvantages

The land use scenarios cannot always be expected to produce better results. With the maximum transit improvements, the total transit trips ranges from 139,000 -215,000. This is 6 to 39 percent lower than what Alternatives One and Six show. Also, the land use scenarios do not show significant improvements in terms of the percentages of freeway and major arterial lane miles at LOS F compared with the six alternatives.

While the results show that travel can be minimized by changing land use patterns, there are considerations that have to be met. There should be high density residential development within close proximity of the transit services, there should be a wide range of housing types, and there should be a jobs-housing balance. Equally important is that the local and regional plans recognize the interplay among these key factors.

FIGURE 6.1

EVALUATION CRITERIA MATRIX

Evaluation Criteria	1984 Conditions	Build only projects with currently assured funding - 2010 "Base"	Alternatives 1-6 Existing Land Use Patterns Mandatory TCM, LRT extensions Rt 102, Rt 65/148	Demonstration Scenario Impacts of land development patterns on travel demand Alternative development patterns Mandatory TCMs LRT extensions
Transportation System Characteristics:				
Lane Mile:				
Freeway	1,051	1,112	1,232 - 1,699	1,231 - 1,236
Major Arterials	1,476	1,872	2,070 - 2,268	2,027 - 2,052
LRT System Miles	0	18.3	48.8 - 63.2	63.2
Bus Line Miles	1,172	816	891 - 1,078	1,078
Weekday Statistics:				
Vehicle Miles Traveled	21,873,000	49,636,000	45,413,000 - 48,523,000	40,134,000 - 43,701,128
Total Transit Trips	39,430	94,130	114,100 - 228,100	139,000 - 215,000
Total Vehicle Trips	4,397,747	8,214,670	7,645,000 - 8,045,000	6,799,000 - 7,402,386
TCM Trip Reduction		-----	221,300 - 663,960	589,648 - 641,663
Peak-Hour Statistics:				
Vehicle Hours of Delay	20,183	101,500	38,412 - 55,980	36,231 - 56,478
Lane Miles-LOS A-D				
Freeways	1,000	433	588 - 1,195	633 - 745
Major Arterials	1,205	1,154	1,544 - 1,724	1,567 - 1,651
Lane Miles-LOS E				
Freeways	31	107	114 - 192	178 - 223
Major Arterials	85	83	104 - 121	63 - 76
Lane Miles-LOS F				
Freeways	20	572	312 - 494	217 - 375
% Freeway Lane Miles	2%	52%	18% - 40%	18% - 30%
Major Arterials	186	635	300 - 440	368 - 409
% Major Arterial Lane Miles	13%	34%	14% - 20%	13% - 20%

CHAPTER VII. ISSUES, FINDINGS AND RECOMMENDATIONS

The Metro Study began as a vehicle to assess transportation needs of the year 2010. Throughout this process it has become increasingly evident that given current development patterns and growth projections, air quality and transportation needs projected for the future simply cannot be met as adequately as they are today. This is based upon current general plans and growth projections for the region and analysis of numerous transportation facilities that have been proposed.

The study was designed to identify a list of projects that provides the greatest amount of congestion relief, in light of air quality and cost considerations. A limited analysis of air quality related impacts was also completed. However, the study was not able to fully address these issues or to address the impacts these projects may have on the natural environment, growth, and ultimate quality and style of life currently enjoyed in the region. These are issues the policy makers must address, given the needs assessment that has been completed.

The following pages include identification of many of the issues facing the policy makers, and the findings and recommendations the Metro Study.

AIR QUALITY ANALYSIS

The Metro Study includes an analysis of the relative impacts of the base case and the alternatives on air pollutant emissions. In addition, the Metro Study analysis provides information ~~only~~ on some general indicators of air quality, i.e., VMT, total daily vehicle trips, and lane miles at LOS F. The study was not able to fully quantify air quality impacts of the different alternatives due to the lack of ozone concentration data.

Findings

As expected, differences in the air pollutant emission impacts of Metro Study alternatives are not large. All scenarios, including the 2010 Base, show a reduction in ozone precursors over those from 1984. However, most of the reductions in ozone precursor emissions have taken place in the last five years (1984-1989) through improvements in the State's motor vehicle control program. Thus, current air quality levels in Sacramento make it clear that, given current population and land use development projections, no Metro Study alternative sufficiently reduces emissions. More complete analysis of air quality impacts of changes in travel behavior and transportation systems will be possible using the Urban Airshed Model.

Recommendations

1. Region-wide air quality analysis of the transportation system recommended in this report, and other transportation alternatives to be determined by SACOG in updating its Regional Transportation Plan, should be conducted using the Urban Airshed Model to assess consistency with the requirements of the California and Federal Clean Air Acts. In the interim, analysis of the impacts of transportation alternatives on air pollutant emissions should be used.

2. SACOG should work with the air districts in the development of the 1992 Regional Transportation Plan to include an alternative that maximizes the reduction of air pollution emissions in order to meet the transportation-related requirements of the California and Federal Clean Air Acts.

3. In addition to Alternative Six, the projects included in Alternative One and the Demonstration Alternative should be used as a basis for further analysis as part of the air quality planning process, as should an alternative that maximizes reductions of air pollution emissions.

TRANSPORTATION CONTROL MEASURES

Reducing the peak-period trips by 15 percent greatly contributed to the reduction in VMT and Vehicle Hours of Delay. Developing and implementing TCMs that would make such a reduction would require significant time and money. Measures necessary to make such a reduction may also be unpopular and difficult to enforce.

Findings

Results shown in the Metro Study that can be attributed to TCMs were not achieved through modeling TCM specific programs. It was shown, however, that a reduction of peak hour trips by 15 percent due to TCMs could provide substantial congestion relief.

Recommendations

1. Significant policy changes and development of an extensive program of transportation control measures, including but not necessarily limited to, those measures identified in Phase I of the Air Quality Plan update should occur in order to make reductions in congestion and improvements in air quality.

2. Local jurisdictions and Caltrans should participate in SACOG's HOV system study and should incorporate the findings of the HOV system study in their appropriate plans. The study should be expedited to ensure that projects are able to be included in the 1990 State Transportation Improvement Program.

COORDINATION OF LAND USE AND TRANSPORTATION PLANNING

Given the existing land use projections, no Metro Study alternative succeeded in completely alleviating the projected congestion. Congestion can be mitigated by reducing vehicle travel demand, or developing a system to meet a given demand. Different types of facilities promote different types of growth and have different air quality impacts. Land use plans designed to minimize vehicle travel demand should be developed in coordination with new roadway or transit facility development.

Findings

As shown in the Metro Study demonstration scenario, alternative land uses, if implemented on a large scale throughout the Metro area, can significantly reduce travel demand.

Recommendations

1. Cities and counties should amend general plans to include mixed-use development (i.e., land use development of bus various densities and at various sizes such as Pedestrian Pockets and other similar land use concepts) along proposed and existing transportation corridors in order to help reduce travel demand. Higher density housing -- to the extent it is desired in each community -- should be within walking distance of light rail stations or major bus lines. Even in the absence of convenient transit, however, mixed uses and higher densities tend to reduce travel demand and should be emphasized accordingly.

2. SACOG should provide a forum for the coordination of transportation evaluation of local general plans in an effort to reduce region-wide travel demand.

YEAR 2010 FACILITIES NEEDS

Identification of transportation facilities needed to accommodate traffic projected for the year 2010 is based strictly on travel demand and amount of congestion relieved.

Findings

Given the existing general plans, policies and land use projections, the combination of roadway and transit projects included in Alternative Six provides the greatest amount of system-wide relief. Alternative Six combines transit extensions, Transportation Control Measures (TCMs), and both Route 102 and Route 65/148. Vehicle miles traveled (VMT) decreases approximately 8.5 percent from the 2010 Base, four times the percent of decrease in Alternatives Two through Five. Alternative Six provides the greatest relief in vehicle hours of delay and lane miles at LOS F. Additionally, it provides reduced traffic volumes on significant sections of the system.

The inclusion of certain new roadways in the Alternative 6 project list -- especially Route 102 and Routes 65/148 -- has raised concerns about growth inducement and increases in auto travel. It is recognized, however, that all major transportation construction projects must be evaluated with respect to social, air quality, environmental, and land use impacts, costs and benefits, and a full range of alternatives. Furthermore, although the Route 102 and Routes 65/148 corridors were evaluated by simulating them with capacity assumptions indicative of freeways, the substantial travel demand exhibited in each corridor could be served instead by different combinations of light rail, bus transit, local roads, highways or expressways, bicycle facilities, and intermodal transfer stations.

Recommendation

The projects included in Alternative Six should be advanced to the next appropriate stage of project review or development with the stipulations below applied to new facilities. The corridors between South Placer, Folsom, and Elk Grove and between Auburn and the Metro Airport and all other new projects or facilities should be planned as multi-modal corridors (or projects) and designed to maximize transit use, carpooling, walking, and bicycling. See map 7.1. The debate over the timing of construction, the appropriate mix of modes of travel, and other design features should continue, but in order to avoid precluding future options it is critical that the necessary transportation corridors be recognized, identified, and protected soon. Cities and counties should commit to protecting rights-of-way for transit, bicycle, and road facilities in these corridors. Although all modes could be accommodated within the same right-of-way, they could also be developed in separate rights-of-way.

Recognizing that the Sacramento area is not attaining federal or state air quality standards, transit and non-motorized transportation facilities and implementation of TCMs should be given the highest priority. This does not imply that important road and bridge projects should be withheld pending completion of all transit recommendations, but it does mean that if transportation benefits and the costs of competing road and transit projects are similar, the priority should go to the transit project.

TRANSIT

The Metro Study analyzed two transit alternatives. The most extensive of these--even when combined with extensive roadway improvements--did not completely alleviate roadway congestion projected in 2010.

Finding

Potential benefits of a vastly expanded transit system are currently unknown.

Recommendation

A region-wide study should be conducted to determine the level of mass transit that would be needed to serve the currently-projected travel demand with LOS results similar to those achieved in Alternative Six.

CONTINUING STUDY

There are several special studies and general plan updates underway that may result in travel demand changes and in identification of alternative methods of relieving congestion. The development of SACOG's travel demand model and the opportunity for Metro area public works and planning staffs and elected officials to work together are, in themselves, positive outcomes of the Metro Study.

Finding

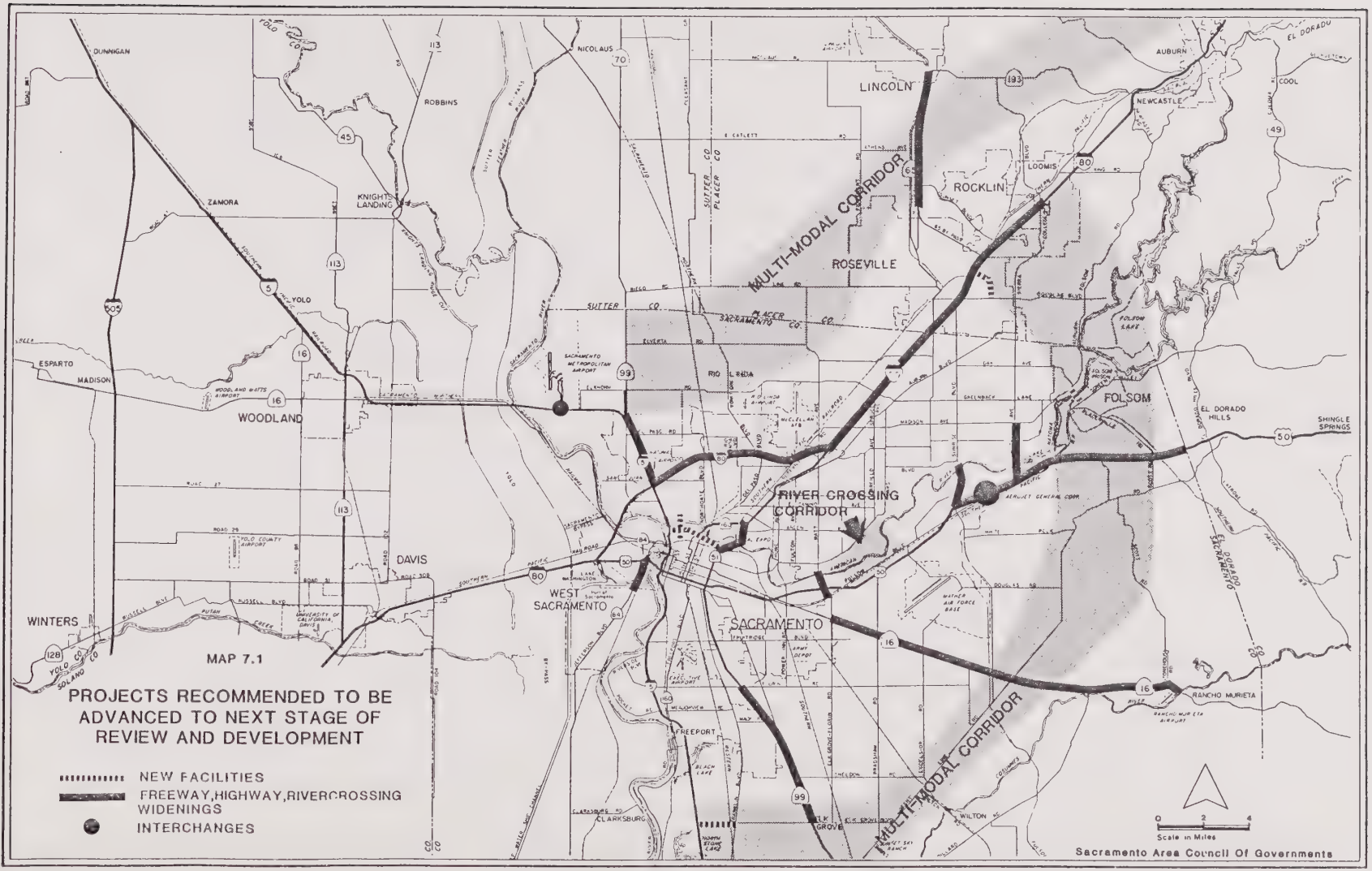
Transportation and air quality planning and land use development are dynamic processes that benefit from ongoing coordination.

Recommendation

The transportation needs of the region should be reassessed on an ongoing basis with the technical support of local public works and planning officials. The review should take into account:

- general plan updates
- route feasibility studies
- results of Regional Transit's System Planning Study which is evaluating light rail extensions to Roseville, Folsom, and Davis, in addition to those extensions recommended here
- results of the Hannigan Rail Study, which is evaluating passenger rail improvements between Auburn and San Jose
- refined analysis of the costs and benefits of the transportation systems represented in Alternatives One and Six and the Demonstration Alternative
- other transportation studies
- development of transportation facilities
- implementation of transportation services
- adoption and implementation of transportation control measures by cities and counties
- analysis of the costs and benefits of transportation projects and systems
- results of urban airshed modeling of alternatives
- air quality plans.

Upon completion of urban airshed modeling and analysis of costs and benefits of alternatives, SACOG should reconvene the Metro Study Policy Advisory and Technical Advisory Committees to consider further recommendations for inclusion of projects in the Regional Transportation Plan, general plans, transit plans, community plans, or Caltrans plans.



MAP 7.1

PROJECTS RECOMMENDED TO BE ADVANCED TO NEXT STAGE OF REVIEW AND DEVELOPMENT

- NEW FACILITIES
- FREEWAY, HIGHWAY, RIVERCROSSING WIDENINGS
- INTERCHANGES

APPENDIX A

SOCIOECONOMIC DATA

The basic data underlying the entire model work is the socioeconomic data. SACOG's Research Section developed the socioeconomic data set used to calculate the total number of person-trip productions and attractions for the modeling area. The socio-economic data set includes the following variables:

- Minor zone number
- Number of single family dwelling units
- Number of multiple family dwelling units
- Number of acres in minor zone
- Amount of retail employment
- Amount of non-retail employment
- Total employment
- Population
- Median household income (in 1969 $)

The dwelling unit estimates were based on SACOG's annual housing module. Employment estimates were based on a combination of data collected from the State Employment Development Department (EDD), a large-employer survey conducted by SACOG, and actual field checks made by SACOG's Research Section to ensure high data integrity.

As described in later sections, population, dwelling units, and income were used to estimate the number of households for each of the following six categories: 0 vehicles, 1 vehicle, and 2 or more vehicles for both single and multiple family dwelling units. The model used these household totals with the corresponding trip generation rates to calculate total trip productions by five trip purposes: Home-Work (H-W), Home-Shop (H-S), Home-Other (H-O), Other-Work (O-W) and Other-Other (O-O). A trip generation rate is defined as the number of person trips each household (or occupied dwelling unit) makes.

Employment and acreage were used to determine the number of trips attracted to each zone by trip purpose. Figure A.1 shows the socioeconomic (land use records) file format.

The following sections discuss in detail how the socio-economic data and other transportation system characteristics were used in the computation of traffic volumes.

TRIP GENERATION

The SACOG model, as discussed above, uses a two-step trip generation process. (See Figure A.2.)

Figure A.3 shows the equations and tables used in the Sacramento Area Transportation Study (SATS) trip generation procedure. The coefficients of the equations were estimated by statistical analysis of data from the 1968 Sacramento Area Transportation Study. The trip generation rates were based on the same study.

The numbers of occupied single and multiple housing units possessing zero, one, and two or more (2+) vehicles are determined in step 1 using the eight equations shown in Figure A.3. The total number of housing units with zero vehicles is first calculated using equation "A". This total is then split into single and multiple housing units using equations "B" and "C". Next, the total number of households owning two or more (2+) vehicles is calculated in equation "D". This total is then broken up into single and multiple housing units using equations "E" and "F". The remaining number of single and multiple housing units with one vehicle are then calculated using equations "G" and "H".

Step 1 results in six sets of numbers which represent the single and multiple housing units split according to three vehicle ownership categories (0,1,2+). However, because the formulas are based on 1968 data, the resulting distribution of 0, 1, and 2+ vehicle households does not reflect the change in relationship between population growth and growth in vehicle ownership.

In step 2, the number of housing units within each vehicle ownership category calculated in step 1 is multiplied by the daily person trip generation rates for each category. The result of step 2 is a preliminary estimate of the number of trips produced in each zone.

Trip generation rates for trip productions were originally taken from Caltrans' SATS MODEL. However, based on a study performed in the San Francisco Bay area in 1981, the Caltrans rates for zero-and one-vehicle households were adjusted upward. The adjustment was made after it was determined in the calibration process that too few trips were being generated. The adjusted rates are provided below as Figure A.4. The "2+" trip rates were raised due to the increased number of "3+" and 4+" vehicle households in the Sacramento area since these rates were developed.

FIGURE A.1

LAND USE RECORDS FORMAT (logical unit 08) *FILENAME ???08.DAT
(See page 9 of the TRPGEN module for further record description)

Production Records

Col Number	Land Use Data	Comments
01	"1"	Code 1
02-04	Zone (Centroid) Number	
05	Blank or Dist. Value	See pg. 4
06-10	# Dwelling Units Assoc w/ Prod. 1	(101)
76		
11-15	# Dwelling Units Assoc. w/ Prod. 2	(102)
16-	Up to 11 MORE Values for Dwelling Units for Productions 3-13. Different if Col 5 is coded.	(103-133)

Attractions Records

01	"2"	Code 2
02-04	Zone (Centroid) Number	
05	Not Used	
06-10	# of Units for Var. 201	
11-15	# of Units for Var. 202	
16-	Up to 11 More Values for Variables 203-213	

Special Generator Records

01	"3"	Code 3
02-04	Zone (Centroid) Number	
05	Blank=Add; Other=Replace	
06-10	Purpose 1; Production Value	
11-15	Purpose 2; Attraction Value	
16-20	Purpose 2; Production 2	
21-25	Purpose 2; Attraction 2	
26-30	Purpose 3; Production 3	
31-35	Purpose 3; Attraction 3	
36-40	Purpose 4; Production 4	
41-45	Purpose 4; Attraction 4	
46-50	Purpose 5; Production 5	
51-55	Purpose 5; Attraction 5	

Station Weight Records

01	"4"	Code 4
02-04	Station # **	
05	Not Used	
06-10	External-Internal (inbound) Value	
11-15	Internal-External (outbound) Value	
16-	Not Used	

FIGURE A.2

THE SATS MODEL TRIP GENERATION PROCEDURE

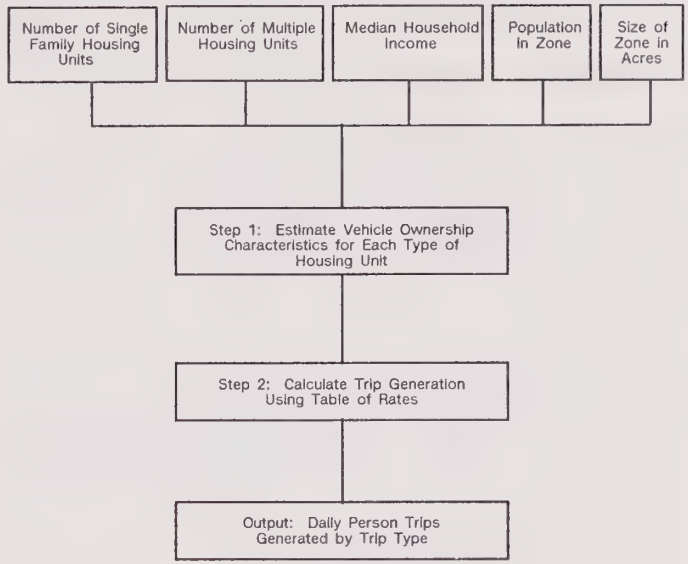


FIGURE A.3

THE SATS MODEL TRIP GENERATION EQUATIONS

Step 1: Calculation of Vehicle Ownership

A. Total number of zero vehicle housing units
= THU x [.18438 + .87178 (1000/MI) - .12052 (Ln Pop/THU) - .10569 (SHU/THU) + .01094 (THU/Acres)]

B. Number of zero vehicle SHU
= (No. of zero vehicle THU) ÷ (1+ 2.6727 MHU/SHU)

C. Number of zero vehicle MHU
= (No. of zero vehicle THU) - (No. of zero vehicle SHU)

D. Total number of 2+ vehicle housing units
= (THU - Total number of zero vehicle housing units) x [.10314 + .27131 (SHU/THU) + .21118 (Arctan (.00016 (MI - 6000)))+ .18591 ÷ (1+ (THU/Acres) + .03487 (Pop/THU)]

E. Number of "2+" vehicle SHU
= (No. of "2+" vehicle THU) ÷ [1+ (0.5529 • (MHU - No. of zero vehicle MHU)/ (SHU - No. of zero vehicle SHU))]

F. Number of "2+" vehicle MHU = (No. of "2+" vehicle THU) - (No. of "2+" vehicle SHU)

G. Number of one vehicle SHU = SHU - (No. of zero vehicle SHU + No. of "2+" vehicle SHU)

H. Number of one vehicle MHU = MHU - (No. of zero vehicle MHU + No. of "2+" vehicle MHU)

Where: THU = Total Housing Units
SHU = Single Housing Units
MHU = Multiple Housing Units
MI = Median Income (1969 $)
POP = Population
Acres = Number of Acres in Zone
Arctan = Arctangent (in Radians)

Step 2: Calculation of Trip Generation

Multiply number of housing units within each vehicle ownership category (from Step 1) by the daily person trip generation rates shown in the following table:

TRIP TYPE	SINGLE HOUSING UNITS			MULTIPLE (& GROUP) HOUSING UNITS		
	Zero Vehicles	One Vehicle	Two+ Vehicles	Zero Vehicles	One Vehicle	Two+ Vehicles
Home-Work	.171	1.362	2.318	.125	1.240	2.071
Home-Shop	.196	1.600	2.096	.163	1.038	1.487
Home-Other	.607	3.728	5.685	.471	2.420	3.760
Other-Work	.020	.464	1.000	.026	.480	1.020
Other-Other	.186	2.082	3.580	.210	2.066	3.387
TOTAL	1.180	9.236	14.679	.995	7.244	11.725

FIGURE A.4

ADJUSTED TRIP GENERATION RATES

TRIP TYPE	SINGLE HOUSING UNITS			MULTIPLE (& GROUP) HOUSING UNITS		
	Zero Vehicles	One Vehicle	Two+ Vehicles	Zero Vehicles	One Vehicle	Two+ Vehicles
Home-Work	.171	1.362	2.447	.125	1.240	2.207
Home-Shop	.196	1.600	2.242	.163	1.038	1.584
Home-Other	.607	3.728	6.068	.471	2.420	3.990
Other-Work	.020	.464	1.066	.026	.480	1.084
Other-Other	.186	2.082	3.825	.210	2.066	3.608
TOTAL	1.180	9.236	15.648	.995	7.244	12.473

TRIP DISTRIBUTION

The model uses the "gravity" method of distributing trips. The number of trips going from one zone to another is calculated based on three factors: the number of trips generated by the origin zone, the relative attractiveness of the destination zone, and the auto travel time between the two zones. Figure A.5 outlines the procedure.

The trip generation stage discussed previously determines the number of trips by trip purpose produced in each zone.

The relative attractiveness of each zone is determined by calculating an attraction factor for each zone and taking the ratio of the zone's attraction factor to the sum of the attraction factors for all of the zones in the study area. A separate set of attraction factors is calculated for each trip purpose. The attraction factor equations used were calibrated from the 1968 SATS Study and are shown in Figure A.6. The home-work trip attraction factors were modified to be consistent with the results of the 1976-1980 Statewide Travel Survey.

The model accounts for the effect of travel time on trip distribution by means of a travel time "factor." Home-work trips are distributed based on the peak hour auto travel times between zones. The remaining trips are distributed using off-peak auto travel times between zones. The travel time factors for each trip type were calibrated based on data from the 1968 SATS Study. These are shown in Figure A.7.

SPECIAL GENERATORS

When the SATS trip generation and distribution models were tested against observed trip data in 1968, study staff discovered that the generation and distribution equations by themselves did not estimate well the number of trips produced or attracted by special activity centers in the study area. These special trip generators are: Air Force Bases, Colleges, Shopping Centers, Hospitals, and the Sacramento Metropolitan Airport. Consequently, separate procedures were developed to account for these discrepancies.

The model's estimated number of trips produced (for all trip purposes) for McClellan and Mather Air Force Bases were adjusted according to the factors shown in Figure A.8. Adjustments were made for other-work and other-other trip productions and home-other trip attractions for the colleges in the study area (U.C. Davis, Sierra College, American River College, Sacramento State, Sacramento City College, and Cosumnes River College) in the affected zones (see Figure A.9). For these zones

(except U.C. Davis) the other-other and other-work trip generation reallocation factors were increased by an adjustment factor times the projected number of student parking spaces at each of the colleges. The home-other trip attraction factor for each college was increased to 2.3 times the number of student parking spaces.

The original model estimates for other-work and other-other trip generation and home-shop trip attractions for shopping centers (Florin, Roseville, Arden Fair, Country Club Center and Plaza, Sunrise, Birdcage Walk, Southgate, Town and Country, plus other miscellaneous centers) are modified according to the equations shown in Figure A.10. The final model estimates of other-work and other-other trip production are augmented by the projected retail employment in the zone times an adjustment factor. A new equation (different from the attraction equation shown in Figure A.4) is used to calculate the home-shop attraction factor for shopping center zones. This new equation eliminates a "parking factor" included in the general equation that inhibits home-shop trip attraction according to the density of development in the zone.

The home-other and other-other trip attraction factors for zones with hospitals (Sacramento Medical Center, Kaiser, Mercy, and Sutter General) are increased according to the values shown in Figure A.11.

The zonal trip production and the zonal trip attraction factors for the Sacramento Metropolitan Airport are adjusted so that the model's estimate of the numbers of trips produced and attracted are approximately equal to those shown in Figure A.12.

FIGURE A.5

THE SATS MODEL TRIP DISTRIBUTION PROCEDURE

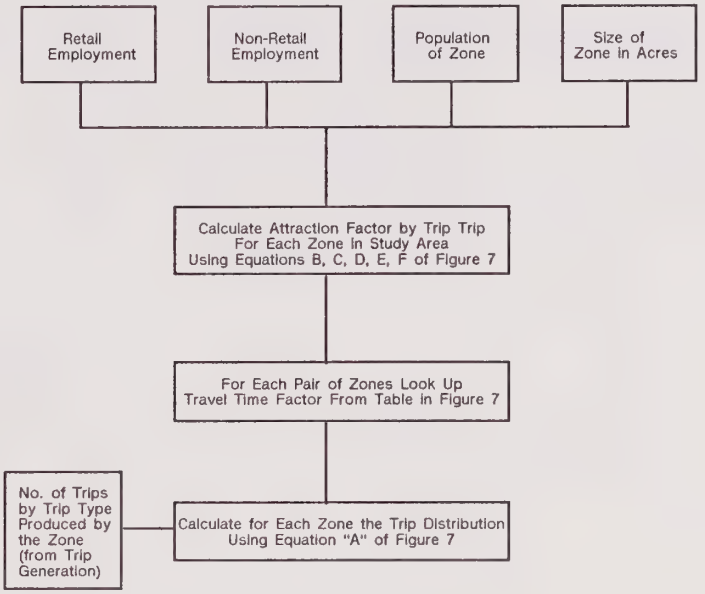


FIGURE A.6

THE SATS MODEL TRIP DISTRIBUTION EQUATIONS

Trip Distribution Equation (same equation for all 5 trip types)

A. $Tij = Pi \times F(Tij) / \sum_{j=1}^{n} (Aj \times F(Tij))$

Where:

Tij = Number of trips produced in Zone "i" that are attracted to zone "j" for the trip type being analyzed.

Pi = Number of trips produced in Zone "i" for trip type being analyzed.

Aj = Attraction factor for Zone "j" (see below).

F(Tij) = Travel time factor for trips between Zone "i" and "j" (see below).

Attraction factors Equations

B. for Home-Work: $Aj = 34.31567 + 1.39974\ TE$

C. for Home-Shop: $Aj = -11.03247 + 10.86557\ [RE/(1 + 0.5\ (TE/Acres))]$

D. for Home-Other: $Aj = 146.3562 + 0.66544\ Pop + 3.86057\ RE + 0.34734\ NRE$

E. for Other-Work: $Aj = -33.20018 + 27.48297\ (\sqrt{NRE + 64}\ | -8) + .83077\ RE$

F. for Other-Other: $Aj = 3.86670 + 217.28723\ (\sqrt{RE + 49}\ | -7) + .21416\ Pop$

Where:

Aj = Attraction Factor for Zone j
TE = Total Employment in Zone j
RE = Retail Employment in Zone j
NRE = Non-Retail Employment in Zone j
Pop = Population of Zone j
Acres = Number of Acres in Zone j

FIGURE A.7

1984 TRAVEL TIME FACTOR FILE (FRICTION FACTORS)

Minutes	Home-Work	Home-Shop	Home-Other	Other-Work	Other-Other	I-X	X-I
1	46000	22000	31000	45000	17000	17000	17000
2	46000	13346	21439	31101	11766	17000	17000
3	46000	8095	14823	21504	8144	17000	17000
4	37000	4910	10249	14868	5636	12000	12000
5	33000	2978	7086	10280	3901	6200	6200
6	27000	1806	4900	7108	2670	4400	4400
7	22300	1096	3388	4915	1869	3100	3100
8	20000	664	2342	3398	1293	1900	1900
9	17300	403	1619	2349	895	1500	1500
10	13000	244	1119	1624	620	1050	1050
11	12000	148	774	1123	429	1000	1000
12	11000	90	535	777	297	750	750
13	9400	54	370	537	205	620	620
14	8000	33	256	371	142	470	470
15	6400	20	177	257	98	410	410
16	5800	12	122	178	68	320	320
17	4900	7	85	123	47	250	250
18	4200	4	58	85	33	220	220
19	3600	3	40	59	23	180	180
20	3100	2	28	41	16	150	150
21	2600	1	19	28	11	120	120
22	2200	1	13	19	7	100	100
23	1800	1	9	13	5	86	86
24	1600	1	6	9	4	76	76
25	1300	1	4	6	2	64	64
26	1150	1	3	4	2	54	54
27	960	1	2	3	1	46	46
28	870	1	1	2	1	39	39
29	685	1	1	1	1	35	35
30	590	1	1	1	1	29	29
31	500	1	1	1	1	24	24
32	460	1	1	1	1	21	21
33	370	1	1	1	1	18	18
34	320	1	1	1	1	15	15
35	270	1	1	1	1	13	13
36	230	1	1	1	1	12	12
37	200	1	1	1	1	10	10
38	170	1	1	1	1	9	9
39	155	1	1	1	1	9	9
40	135	1	1	1	1	8	8
41	120	1	1	1	1	7	7
42	105	1	1	1	1	6	6
43	90	1	1	1	1	6	6
44	80	1	1	1	1	5	5
45	70	1	1	1	1	5	5
46	62	1	1	1	1	5	5
47	54	1	1	1	1	4	4
48	46	1	1	1	1	4	4
49	40	1	1	1	1	4	4
50	36	1	1	1	1	3	3
51	32	1	1	1	1	3	3
52	28	1	1	1	1	3	3
53	25	1	1	1	1	2	2
54	22	1	1	1	1	2	2
55	19	1	1	1	1	2	2
56	17	1	1	1	1	2	2
57	15	1	1	1	1	2	2
58	14	1	1	1	1	2	2
59	12	1	1	1	1	2	2
60	11	1	1	1	1	2	2
61	10	1	1	1	1	1	1
62	8	1	1	1	1	1	1
63	7	1	1	1	1	1	1
64	7	1	1	1	1	1	1
65	6	1	1	1	1	1	1
66	5	1	1	1	1	1	1
67	5	1	1	1	1	1	1
68	4	1	1	1	1	1	1
69	4	1	1	1	1	1	1
70	4	1	1	1	1	1	1
71	3	1	1	1	1	1	1

FIGURE A.8

SATS MODEL AIR FORCE BASE ADJUSTMENT FACTORS

Multiply model estimated trip productions for these zones by the following factors:

Air Force Base	Zone Number	Home Work	Home Shop	Home Other	Other Work	Other Other
McClellan	313	0.50	0.60	0.30	0.25	0.25
Mather	565	0.10	0.80	1.50	1.10	0.90
Mather	566	0.20	0.30	0.50	0.00	0.00

Source: CALTRANS 03 memo "SATS Special Generators (9-5-73) - Final 1995 Special ATT/"

FIGURE A.9

SATS MODEL COLLEGE CAMPUS ADJUSTMENT FACTORS

Estimated trip productions for these zones by the following factors times the number of student parking spaces:

College Campus	Zone Number	Student Parking Spaces 1984	Home Other	Other Work	Othe Othe
UC Davis	081	7,600	2.3		
Sierra College	191	1,850	2.3	0.7	0.2
American River College	383	6,000	2.3	0.7	0.2
CSU Sacramento	514	9,000	2.3	0.7	0.2
Sacramento City College	661	2,725	2.3	0.7	0.2
Cosumnes River College	720	4,000	2.3	0.7	0.2

Source: Caltrans 03 Memo, "SATS Special Generators (9-5-73) - Final 1995 ATT/"
Parking spaces reflect actual parking available in 1984.

FIGURE A.10

SATS MODEL SHOPPING CENTER ADJUSTMENT FACTORS

Multiply model estimated trip productions for these zones by the following factors multiplied times retail employment in the zone:

Shopping Center	Zone Number	Home Shop	Other Work	Other Other
Southgate	702	-11.03247+(10.86557)	0.6	2.9
Roseville	173	-11.03247+(10.86557)	0.6	2.9
Arden Fair	342	-11.03247+(10.86557)	0.6	2.9
Country Club Center	351	-11.03247+(10.86557)	0.6	2.9
Country Club Plaza	358	-11.03247+(10.86557)	0.6	2.9
Town & Country	375	-11.03247+(10.86557)	0.6	2.9
Birdcage Walk	445	-11.03247+(10.86557)	0.6	2.9
Sunrise Mall	440	-11.03247+(10.86557)	0.6	2.9
Florin Center	498	-11.03247+(10.86557)	0.6	2.9
Freeport Blvd	665	-11.03247+(10.86557)	0.6	2.9

Source: CALTRANS 03 Memo, "SATS Special Generators (9-5-73) - Final 1995 Special ATT/" and CALTRANS 03 Memo to J. A. Legarra from E. W. Blackmer, 7-19-71.

FIGURE A.11

SATS MODEL HOSPITALS ADJUSTMENT FACTORS

Increase home-other and other-other attraction factors by amounts shown below.

Hospital	Zone Number	Adjustments for Home-Other Trips 1984	2010	Adjustments for Other-Other Trips 1984	2010
Kaiser	352	+5,800	+5,800	+4,300	+4,300
Mercy	470	+900	+900	+700	+700
SAC Medical Center	477	+900	+900	+1,200	+1,200
Sutter General	774	+900	+900	+2,500	+2,500

New Attraction Factor = (Old Attraction Factor) + (Adjustment)

Sources: 1)CALTRANS 03 Memo #03106-612160 "Sacramento Special Generator Study," January 29, 1971 from E. F. Galligan to J.A. Legarra - Attn. D. L. Wieman.

2)CALTRANS 03 Memo "SATS Special Generators (9-5-73)."

FIGURE A.12

SATS MODEL SACRAMENTO
METROPOLITAN AIRPORT ADJUSTMENT FACTORS

Set the number of trips produced equal to those values shown in the table. Adjust the trip attraction factors so that the number of trips attracted by the airport zone are equal to those values shown in the table.

Trip Purpose	Zone Daily Trips Produced 1980	Daily Trips Attracted 1984
Home-Work	0	1,560
Home-Shop	0	325
Home-Other	0	7,537
Other-Work	1,814	328
Other-Other	2,413	2,343
Total	**3,300**	**11,700**

Source:Adjusted up 30% - CALTRANS 03 Memo, "SATS Special Generators (9-5-73)." Based on discussions with airport staff.

MODE SPLIT

The mode split is calculated using a portion of Peat, Marwick, and Mitchell's San Diego N-Logit Modal Choice Model modified and calibrated to the Sacramento area. It estimates the proportion of home-based trips made via transit.

The Model estimates the transit trip by first determining the minimum time transit paths between all transit accessible links. After the minimum time transit paths are selected, the Model estimates mode split for each zone. Resulting transit trips are then assigned to the minimum time transit paths.

The mode split for home work is calculated for each trip direction (productions and attractions) for each zone based on the following variables:

1) The income distribution in the origion (trip production) zone;

2) The difference in travel time between auto and transit travel;

3) The difference in travel access time between auto and transit;

4) The difference in user perceived costs of auto and transit travel; and

5) Parking costs

After the home-work transit trips have been determined, the non-home-work trips are estimated. It is assumed that the home-work trips equaled approximately 54 percent of total transit trips. Finally, all of the estimated transit trips are subtracted from the total number of person trips between zones. This subtraction is completed before the person trips are converted to auto trips, and before the auto trips are assigned to the roadway network.

The model dictates a number of parameters that affect transit ridership. These are indicated, along with the input values used for 1984 and 2010, in Figure A.14.

FIGURE A.13

THE SATS MODEL MODE SPLIT EQUATIONS FOR HOME-WORK TRIPS

$$Ppt = \frac{\exp(.1119DA + .0339DL + .0178DC + .7586)}{1.0 + \exp(.0256TI - .7492) + \exp(.1119DA + .0339DL + .0178DC + .7586)}$$

Nomenclature:

Ppt = Percentages of trip being made by transit

exp = Exponential operator(e)

TI = Transformed household income for each income category in 1968
= 100 [1-exp (-0.0004 x Household Income)]

DA = Difference in access time (minutes)
= Walk to/from auto time - (walk to transit time + walk from transit + 1st wait for transit)

DL = Difference in travel time (minutes)
= Auto driving time - (transit in vehicle time + transit transfer time)

DC = Difference in perceived modal cost (cents)
= Auto operating cost (cents/mile x distance) + half of parking cost transit fare

Source: "Condensed Description of the Sacramento N-Logit Modal Choice Model," by Ken Seifert, Transportation Systems Modelling Branch, DOTP, CALTRANS, as published in the Technical Supplement to the Sacramento Northeast Corridor Study, September 1976, SRAPC.

FIGURE A.14

TRANSIT BEHAVIOR VARIABLE AND PARAMETERS SET WITH THE TRNPTH MODULE OF THE TRANSIT JOB-STREAM

Variable	1984 Value	2010 Value
1. Walking Speed	2 miles per hour	2 miles per hour
2. Initial wait	Not more than 20 min.	Not more than 20 min.
3. Transfer wait	Not more than 60 min.	Not more than 60 min.
4. Initial and destination walking	Up to .35 mile distance	Up to .35 mile
5. Transfer walking distance	Up to .25 mile	Up to .25 mile
6. Time factors		
Perceived walk access time	2.5	2.5
Perceived walk transfer time	3.0	3.0
Perceived waiting time	2.5	2.5
Multiple line time factor	0	0
7. Stop time for buses	15 seconds	15 seconds
8. Bus speed (relative to car speed)		
Regular routes	65%	65%
Express routes	80%	80%
9. Maximum number of transfers	1	*2
10. Perceived vehicle travel cost/mile	15 cents (1984 dollar)	15 cents

*During the calibration process, model estimates of transit ridership were less accurate when two transfers were allowed. Prior to the introduction of light rail in 1987, one transfer was sufficient for the overwhelming majority of trips serviced by RT.

EXTERNAL TRIP ESTIMATION

Three types of trips are external to the modeling area:

1) Trips originating in the modeling area with an outside destination (external-internal).

2) Trips originating outside with a destination inside the modeling area (external-internal).

3) Trips with both origins and destinations outside of the modeling area (external-external or through trips).

External trip estimation in the model is important because it regulates the amount of traffic allowed to pass into and outside of the modeling area boundaries. There are seventeen model access points on state and federal highways, and thirty access points, or cordon stations, in all. Map A.1 shows the modeling area cordon stations.

The 1984 total cordon count was determined by actual 1984 traffic counts at these locations. For the most part, these were obtained from Caltrans District 3. However, counts for local roads were obtained through local jurisdictions. Through trips were only estimated for the major state and interstate highways. These numbers were provided by Caltrans District 3 based on their travel studies. Figure A.15 shows the cordon-station traffic counts used in the 1984 model.

External trips are distributed using the model based on the gravity-model equations and a designated percent of a zone's trips to external trips. The calibration process revealed that a single external trip percentage for all zones did not reflect the higher external trip travel likely from areas near major cordon stations. To account for this, different percentages of external trips were calculated for different areas as listed below:

PRODUCTIONS

- Woodland - 3.6%
- Galt - 16.0%
- No. of Galt, So. of Cosumnes River - 4.0%
- So. of Meadowview (along I-5) - 25.0%
- All other areas - 1.5%

ATTRACTIONS

- All areas - 2.2%

MAP A.1

CORDON STATION MAP

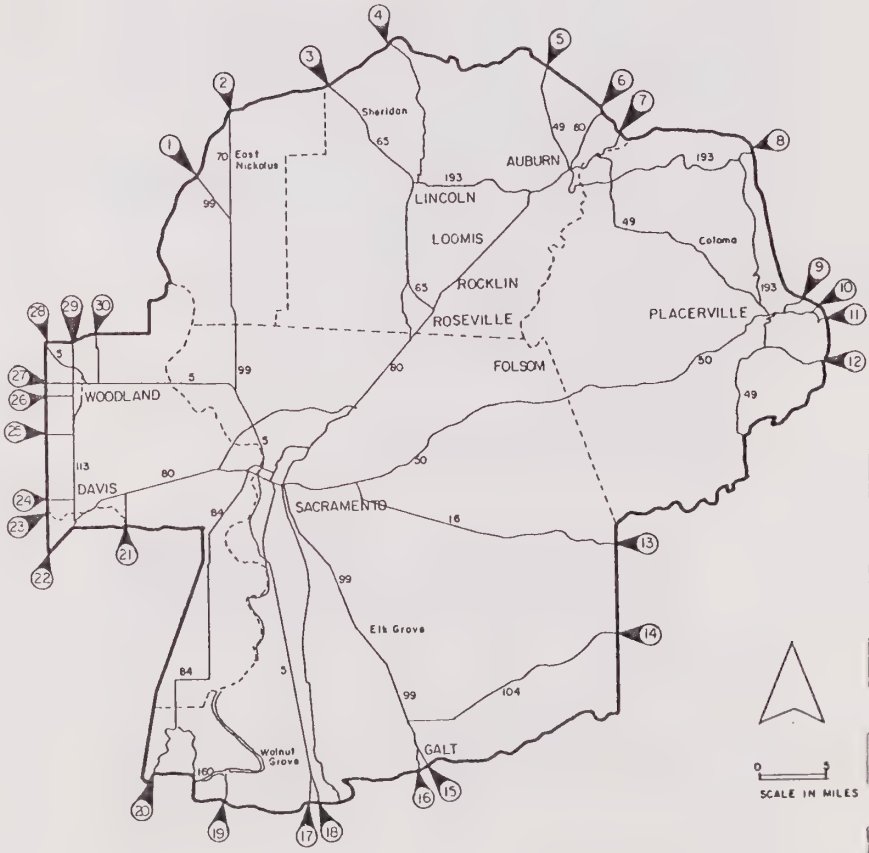


FIGURE A.15

SACOG 1984 MODEL
CORDON-STATION COUNTS

CORDON STATION #	LOCATION	X-I, X-I TRIPS	THROUGH TRIPS	TOTAL TRIPS
1	SR-99 (North)	5,600	1,276	6,876
2	SR-70 (North)	4,260	1,563	5,800
3	SR-65 (North)	5,500	697	6,197
4	McCourtney Rd.	1,800	0	1,800
5	SR-49 (North)	9,260	1,356	10,616
6	I-80 (East)	10,980	9,262	20,242
7	Foresthill Rd.	3,488	0	3,488
8	Wentworth/Geo.town	2,294	0	2,294
9	Carson Road	2,718	0	2,718
10	SR-50 (East)	14,840	3,841	18,681
11	Newton Road	1,840	0	1,270
12	Pleasant Valley Rd.	1,024	0	1,024
13	SR-16	3,480	127	3,607
14	SR-104	1,320	87	1,407
15	SR-99 (South)	20,880	4,494	25,374
16	Lincoln Road	2,800	0	2,800
17	Franklin Road	2,150	0	2,150
18	I-5 (South)	15,140	4,354	19,494
19	SR-160 (South)	1,900	0	1,900
20	SR-84 (South)	400	0	400
21	CR-104	1,380	0	1,380
22	I-80 (West)	39,200	14,788	53,988
23	SR-128	1,700	0	1,700
24	Russell Blvd.	3,088	0	3,088
25	CR-27	480	0	480
26	CR-24	4,690	0	4,690
27	SR-16	7,240	448	7,688
28	I-5 (North)	8,240	3,946	12,186
29	SR-113 (North)	3,520	559	4,079
30	CR-102	4,440	1,165	5,605

Source: CALTRANS District 3 and Local Jurisdictions

Note: X means external, I means internal

NETWORK ASSIGNMENT

The assignment of auto driver trips used a highway network developed by SACOG. The network consists of two types of links: freeway and other streets. The other streets are further divided into major arterial, minor arterial, and collector streets. The freeway links are connected to street links with on-and-off ramp lanes. The centroid of each zone (the point within a zone at which, in theory, all trips begin or end) is connected to the roadway network by an artificial link. All trips produced and attracted by the zone are assigned to this artificial link.

Each link has characteristics that describe the distance, speed, number of lanes, type of roadway, and several other factors. Figure A.16 shows the format for the network link-data files. The various fields help the model to compute the minimum time travel paths and capacity of the roadway system. (See Figure A.17).

Capacity restraint of the network is performed through the model assignment program. For the 1984 model, trips were assigned to the model's minimum time paths on an iterative basis, with capacity restraint applied between each of three iterations. In the first iteration 50% of model auto trips were assigned; volume-to-capacity (VC) ratios were calculated by the model; and an additional time impedance was then added to account for high VCs. The model then calculated new minimum time paths based on the additional time impedance, and assigned 30 percent of the total trips. This process was repeated a third time with the remaining 20 percent of the trips.

After all trips are assigned, a final VC ratio and congested speed are calculated based on the assigned traffic volumes and roadway capacity. Freeway volumes are effected to reflect heavy duty truck volumes. Based on truck volumes documented in the 1987 Truck Volume, the following assumptions are made:

Freeway Type	Truck Volume/Total Volume
Intercity	.04
Suburban	.05
Rural	.07

The final steps of assigning trips and calculating VCs and speeds are the culmination of the modeling process, and the beginning of the analysis process.

FIGURE A.16

LINK DATA RECORD FORMAT (logical unit 07) *FILENAME ????07.DAT
(See page 2 of the NETBLD module for further format descriptions)

Col Number	Link Data	Comments
01	Not Used	
02-05	A-Node	
06	Not Used	
07-10	B-Node	
11	Not Used	
12	Link Direction	
13	Not Used	
14-17	Link Distance	xx.xx format
18	Speed/Time Indicator	T or S
19-21	Speed/Time Impedance	If col. 18 equals "T"
22	Not Used	
23-24	Speed Class (01-63)	From user-created table
25	Not Used	
26-27	Capacity Class (01-63)	From user-created table
28	Not Used	
29	# Lanes (1-7)	
30	Not Used	
31-33	Count	Comparison
34	Not Used	
35	Direction Indicator	1, 2 or blank

RULES FOR CODING LINK DATA

1. All zone centroids are coded as nodes and must be numbered sequentially beginning at node 001.

2. Centroids are not coded as an integral part of the network; they are connected to the network with centroid connector links.

3. Paths do not normally route through centroids.

4. Node numbers (non-centroid) may be used in any order and need not be consecutive. However, keep the highest node number as low as practical to decrease the computer size requirements.

5. Only 8 links can be connected to a single node if turn penalties are to be used. It is better to not code more than 8 links to any node regardless.

6. Direction codes A B C D are not valid if NODES exceeds 4094.

FIGURE A.17

MINUTP CAPACITY CLASS FOR THE SACRAMENTO AREA*

Area Type	Freeway	Expressway	Major	Minor Arterial	Collector Arterial	On/Off Ramps	Centroid Connectors
CBD	11 (1200)	12 (1200)	13 (750)	14 (550)	15 (400)	16 (700)	63 (9000)
CBD--Fringe	21 (1200)	22 (1200)	23 (750)	24 (550)	25 (400)	26 (700)	63 (9000)
Residential	31 (1200)	32 (1200)	33 (750)	34 (550)	35 (400)	36 (700)	63 (9000)
Outlying CBD (Industrial)	41 (1200)	42 (1200)	43 (750)	44 (550)	45 (400)	46 (700)	63 (9000)
Rural	51 (1100)	52 (1100)	53 (750)	54 (550)	55 (400)	56 (700)	63 (9000)

* Volume capacities are set within the MINUTP program run.

NOTE: The two-digit numbers represent a code used by MINUTP to reference the capacity by area type and facility type. The numbers in parentheses represent the free-flow capacities used in a recent model run.

MODEL CALIBRATION

Model calibration is a technique of adjusting each part of the modeling process to make it more descriptive of traffic and travel characteristics of the time-period being studied. SACOG's model was calibrated using the daily traffic volume. That means that the total traffic assigned to the roadways was meant to conform with actual counts from 1984.

Traffic counts were obtained from several sources. The 1984 Caltrans freeway count book was used for freeways. The counts from or around 1984 were used as available for local streets. In general the calibration process went as described below.

After SACOG's socio-economic data was produced and the network update completed, model runs were made on a regular basis. After each model run, various model outputs were reviewed and evaluated for accuracy or acceptability. First, the total trips generated had to be checked to ensure that a reasonable number of trips were being generated based on previous modeling efforts. Next, the model's minimum travel paths were reviewed for reasonableness in both total travel time and the travel path.

Total vehicle trips were checked after vehicle occupancy rates were applied. Finally, the model assignment was analyzed for reasonableness in vehicle loadings. This analysis also provided clues to problems in trip generation, trip distribution, mode split, or vehicle occupancy rates.

To evaluate each model run, the model computes the difference between the ground counts and the estimated traffic volumes. The model then summarizes the figures for each facility type. dBASE III was used to compute the root-mean-squared error (RMSE) by facility type. The RMSE describes the degree of variation between the actual count and the estimated traffic volume and was calculated using the following formula:

$$RMSE = \sqrt{[\Sigma(\text{volume-count})^2/\#\text{ link counts}]/(\Sigma\text{ counts}/\#\text{ link counts})}$$

The RMSE figures for the end of the calibration are given in Figure A.18.
The rule of thumb for calibration (given to us by COMSIS, the MINUTP developer) is that a facility carrying 100,000 vehicles should be no more than 10% off in the model, and that a facility carrying 10,000 vehicles should be no more than 50% off.

Obviously, the higher the traffic volume, the easier it is to model. Given this rule-of-thumb and the average volumes of freeways in 1984, which averaged well under 100,000 ADT, the 1984 model was successfully calibrated.

FIGURE A.18

FINAL CALIBRATION RMSE

FINAL RMSE	FACILITY
Freeways	12%
Major Arterials	30%
Minor Arterials	39%
Collectors	39%
Overall	23%

APPENDIX B

2010 HOUSING AND EMPLOYMENT ASSUMPTIONS

The distribution of households for 2010 is based on several factors besides the PRU projections, vacancy rates, and household size. These are discussed by jurisdiction in Figure B.1.

Following are detailed assumptions (Figure B.2) and the actual projections by community group for housing, employment and population for 1984 and 2010 (figures B.3 & B.4), as well as Map B.1 which shows those community groups.

JOB STREAM CHANGES

Some changes were also made in the model job-stream. These were few but of importance. Listed below are the basic changes that occurred.

Trip Generation and Distribution

No changes were made in the trip generation rates from the calibrated model. Friction factors used in trip distribution were held constant except for the home-work trip purpose. This column was changed to allow for longer commute trips. The updated friction factor file is included as Figure B.5.

Mode Split

Mode split was performed for home-work trips via the transit model. Other transit trips were estimated based on an assumed 54 percent of transit ridership as home-work. Numerous park-and-ride lots were added to the network and an allowance for riders to make a maximum of two transfers.

Peak-Hour Trips

The peak-hour trip factor was changed from 11 percent to 9 percent. This was done in response to discussions with Caltrans District 3 and reflects a common phenomenon where peak-hour traffic increases in absolute terms but decreases as a percentage of ADT.

Vehicle Occupancy Rates

Were not changed.

Assignment Technique

The last major change in the job-stream was the assignment technique used. Rather than three iterations of all-or-nothing assignment using increments of 50, 30, and 20 percent respectively, five iterations of all-or-nothing, each with 20 percent increments, were used. This was due mainly to the increase in trips where 50 percent of 2010 traffic was nearly equal to 100 percent of 1984 traffic. Discussions with COMSIS Corp., developer of MINUTP, indicated that it was appropriate to make such changes since traffic behavior changes over time. The five increments introduce more capacity constraint into the assignment.

FIGURE B.1

1984-2010 OCCUPIED HOUSING GROWTH ASSUMPTIONS BY COMMUNITY AREA

AREA	ASSUMPTIONS
SACRAMENTO COUNTY:	
General	Sacramento City projections are based on the Draft General Plan as of September 1987. Sacramento County projections are based on SACOG's housing module which is based on residential zoning as of the summer of 1987 on the county assessor's roles.
North Natomas (1)	Area north of Del Paso Rd.; current Sacramento City General Plan buildout; minor development of the county portions. Assumes no problems from the 100-year flood plain or Sacramento Metro Airport noise contours.
Rio Linda/Elverta (2)	Buildout of current residential zoning, not buildout of available land
North Highlands (3)	Buildout of Antelope
Citrus Heights (4)	Buildout of current zoning; no open land available
Orangevale (5)	Maintenance of rural atmosphere based on the strength of community groups; however, there are significant growth pressures being placed on this community
Folsom Area (6)	Buildout of current zoning map (October 1988)
South Natomas (7)	Area south of Del Paso Rd.; buildout of city portion; could be high due to airport and flood-plain conflicts
North Sacramento (8)	In-fill based on neighborhood turnaround due to proximity to North Natomas
Arden-Arcade (9)	Buildout of open land
Carmichael (10)	Buildout of open land
Fair Oaks (11)	Buildout of open land
Rancho Cordova (12)	Current zoning; substantial portion is Gold River development. Assumes Mather AFB is still in place
Downtown (13)	Based on Sacramento City General Plan; assumes no up-zoning of existing residential land
Land Park/Pocket/ Meadowview (14)	Pocket area development, portion of Laguna, and up-zoning in northern portion of the area so housing is replaced
East City (15)	Buildout of available residential land
South Sacramento (16)	Buildout of available residential land
Vineyard (17)	Vineyard development is a side-effect of Elk Grove growth. More growth is probable after 2010 based on open land.

AREA	ASSUMPTIONS
Franklin/Laguna (18)	Laguna growth; buildout of residentially-zoned land
Elk Grove (19)	Buildout of current zoning; open land available for zoning
Delta (20)	Slow growth; based on past years' trends
Cosumnes (22)	Growth around Wilton, based on current residential zoning; open land available
Southeast (23)	Minimal growth due to rural nature of area
Rancho Murieta (24)	Based on expected growth by county planners
WEST SACRAMENTO (50)	Conservative, assumes no new bridge over the ship canal
PLACER AND EL DORADO COUNTIES	Using the Department of Finance projections as control totals, each jurisdiction or area in these counties was allocated population for 2010. This allocation was based on past growth trends, current planning, and reasonableness when compared to current population.
ROSEVILLE (70)	Current growth policy
ROCKLIN (71)	Close to buildout of current residential zoning
LINCOLN (72)	Current planning in the area

FIGURE B.2

1984-2010 RETAIL AND NON-RETAIL EMPLOYMENT BY COMMUNITY AREA

AREA	ASSUMPTIONS
SACRAMENTO COUNTY:	
General	Sacramento City projections are based on the Draft General Plan as of September 1987. Sacramento County projections are based on buildout of current zoning in the urban areas. Current zoning was determined through the county assessor's roles during 1987.
North Natomas (1)	Area north of Del Paso Rd.; based on projected development; from City General Plan, includes development at and east of Metro Airport.
Rio Linda/Elverta (2)	Buildout of commercially-zoned land (as of summer 1987 county assessor's roles)
North Highlands (3)	Drop in McClellan employment, increase in development of current open land; growth in Antelope and northern overflight zone for McClellan
Citrus Heights (4)	Buildout of commercially-zoned land (as of summer 1987 county assessor's roles)
Orangevale (5)	Continued rural atmosphere; very little land currently zoned commercial
Folsom Area (6)	Based on currently adopted plans (October 1988), growth along the Route 50 corridor and western portion of Blue Ravine Road
South Natomas (7)	Area south of Del Paso Rd.; close to buildout; includes stadium complex; major growth south of Del Paso Road, the N. Market corridor, east and west of I-5 and south of West El Camino
North Sacramento (8)	Redevelopment and in-fill based on Natomas growth
Arden-Arcade (9)	Buildout of commercially-zoned land (as of summer 1987 county assessor's roles)
Carmichael (10)	Buildout of commercially-zoned land (as of summer 1987 county assessor's roles)
Fair Oaks (11)	Buildout of commercially-zoned land (as of summer 1987 county assessor's roles)
Rancho Cordova (12)	Close to buildout; based on current zoning of available land; growth along the Route 50 corridor, Aerojet/Douglas area
Downtown (13)	Increase based on multi-story office projects; growth along R Street, Richards Blvd., and north of C Street, west of I-80
Land Park/Pocket/ Meadowview (14)	Laguna growth; south pocket area, 24th Street and Meadowview area

AREA	ASSUMPTIONS
East City (15)	Substantial growth in Elk Grove/Florin/ Power Inn area, and Campus Commons area
South Sacramento (16)	Buildout of available land; Stockton Blvd. corridor, Mack Road area
Vineyard (17)	Support development in East City; along Elk Grove-Florin Road
Franklin/Laguna (18)	Support Laguna development, south of Sheldon Road
Elk Grove (19)	Elk Grove development and industrial area to the south; growth along the Route 99 corridor and Grant Line Road
Delta (20)	Current commercial zoning
Galt (21)	Growth in northeast area
Cosumnes (22)	Support proposed development; based on zoning as of summer 1987
Southeast (23)	Assumes Rancho Seco decommissioned by 2010
Rancho Murieta (24)	No change
YOLO COUNTY:	
West Sacramento (50)	Based on current development trends; growth in Port area, along Reed Avenue and Enterprise Drive
PLACER COUNTY:	
Roseville (70)	Based on current development trends; development of open land in northern Roseville
Rocklin (71)	Based on current development trends; growth in Stanford Ranch, 65 corridor, based on open land yields
Lincoln (72)	Based on draft general plan as of September 1987 (some of growth shown as Lincoln is truly a part of North Rocklin)
Unincorporated	Based on current development trends
EL DORADO COUNTY	Based on current development trends

FIGURE B.3

1984 COMMUNITY GROUP HOUSING & EMPLOYMENT PROJECTIONS

Community Group	Single-Family Dwellings	Multi-Family Dwellings	Retail Employment	Non-Retail Employment	Population
1	300	4	220	1079	859
2	4788	115	362	1302	16025
3	17316	6234	4957	31383	66563
4	22970	9019	8140	6119	85499
5	7229	1137	1186	2450	24450
6	3579	875	1075	5122	14484
7	4924	1432	622	4160	16294
8	13176	6495	5133	15968	47573
9	20666	17961	8437	27941	86259
10	11467	6120	1901	5735	43968
11	7849	2579	834	1966	28477
12	20837	9604	4119	29252	83937
13	2733	15543	7795	64632	31005
14	26314	9816	3853	16233	93905
15	24996	9853	3081	33963	79662
16	25356	9157	8380	24697	92203
17	1060	1	89	597	3228
18	654	28	20	488	2940
19	4748	836	1092	2440	16538
20	2130	211	215	3245	5757
21	1929	510	283	857	7752
22	1348	16	51	450	4231
23	1087	41	21	1070	3813
24	263	157	3	126	1078
30	1047	10	34	927	2538
50	8006	3358	1576	8759	26281
51	8732	3265	2466	17612	34809
52	9033	7387	1882	15873	450016
53	539	50	32	1318	1987
70	9003	2308	5504	17118	29409
71	3555	744	506	1683	10895
72	3232	364	348	2231	10332
75	3252	981	219	1167	10874
77	3375	187	371	2492	10460
78	3037	141	430	1445	9572
80	2266	76	160	340	5490
81	5657	328	535	1815	16591
82	4286	147	475	1510	11690
83	4734	827	1254	3981	13421
TOTAL	75668	21220	17850	86639	256959

FIGURE B.4

2010 COMMUNITY GROUP HOUSING & EMPLOYMENT PROJECTIONS

Community Group	Single-Family Dwellings	Multi-Family Dwellings	Retail Employment	Non-Retail Employment	Population
1	10618	12202	1217	11692	47405
2	7653	534	546	2005	21788
3	27767	17697	9113	39508	111947
4	27332	15025	10307	11174	99258
5	9764	1947	1451	2689	30522
6	20940	6872	2814	17744	73096
7	13984	12527	4005	63324	56956
8	26533	13295	8520	49925	86136
9	21588	21552	9162	28429	89351
10	13132	9301	2180	6295	52756
11	10130	4414	954	2049	34387
12	24388	15414	11332	68498	100367
13	2749	16349	10158	89811	36202
14	36254	12885	7254	37907	199287
15	25924	10230	9621	67464	79970
16	50832	20498	13607	41113	167881
17	6154	1544	772	2412	20229
18	13122	6884	3987	12836	50823
19	15929	4069	2855	9741	52553
20	2517	254	684	6743	6402
21	8956	1882	369	3763	28583
22	4123	36	173	1493	11118
23	1805	52	36	415	5052
24	3846	254	3	126	10021
30	1400	76	37	1037	4549
50	11939	5333	1719	20942	38122
51	15834	7257	5097	29881	59719
52	15722	12817	3431	24972	75878
53	992	29	39	1270	2505
70	31125	12539	8255	43405	102045
71	11014	4227	1500	13325	35985
72	10395	3607	810	13545	29395
75	8372	1154	650	2452	23294
76	10091	1567	2700	10500	27873
77	6994	240	685	3500	19680
78	6508	318	888	2150	19249
80	6643	223	400	1500	16823
81	13174	1000	1150	5400	36753
82	14235	640	1410	4000	37486
83	6892	1640	2050	7200	19552
TOTAL	171330	52667	30821	185179	546898

APPENDIX C[1]

ESTIMATED DAILY EMISSIONS

Purpose of Emissions Analysis

The purpose of this emissions analysis is to provide a rough cut estimate of the effect of the various transportation alternatives outlined in the Sacramento Area Council of Governments (SACOG) Metro Study on Sacramento air quality.

As expected, the differences in emissions between alternatives are not large. Compared to 1984 emissions levels, all scenarios, the 2010 base case included, show a reduction in the emissions of ozone precursors. However, when compared to 1989 emissionssions, all scenarios show an increase in ozone precursor emissions. This is attributable to improvements in the vehicle fleet in the last five years due to the Air Resources Board's (ARB) motor vehicle control program. In the 1990's the rate of growth in vehicle miles traveled (VMT) will outstrip current controls and without additional controls, air pollution emissions will begin to rise. Given current air quality levels in Sacramento, it is clear that a transportation alternative is needed to provide the sufficient reductions in emissions to attain the California air quality standards. Such an alternative should be included in forthcoming state and federal air quality plans as well as in the 1992 Regional Transportation Plan.

Method

The average daily emissions for 1984, and the 2010 baseline projection and alternatives, were calculated as functions of emissions attributable to unrestricted travel and those emissions produced during increased vehicle hours of delay (VHD), i.e. congestion. This method was chosen as the best course to follow given the lack of available speed data in the Metro Study.

The non-peak hour traffic emissions were determined using the EMFAC7d/BURDEN emissions model. The model was run using VMT and number of daily trips for each scenario as listed in the Metro Study. Assumptions were made on the number of vehicles in use, the number of hot-start trips and the number of cold-start trips. Further assumptions were used to partition the 1984 and 2010 vehicle fleets into representative vehicle classifications. A yearly average temperature of 75° F was used, as well as a speed profile of 50% of VMT at 25 mph, 11 percent at 45 mph and 39 percent at 55+ mph. It was assumed (per information from SACOG) that heavy duty vehicles were included in the weekday statistics (i.e. VMT and trips).

In order to model the effects of congestion on vehicle emissions, the speed profile was held constant for the 1984 and 2010 EMFAC7d runs. This, in effect, factored out congestion. To allow for the effects of congestion, the Metro Study figures for VHD were used and an average congestion speed of 30 miles per hour was assumed. The VHD in the Metro Study was given for a peak hour (rather than a total daily figure). Per the recommendation of Ken Hough of SACOG, daily VHD for 1984 was determined by doubling the given VHD. Similarly, daily VHD for all 2010 scenarios was calculated by multiplying peak hour VHD by 3.

To calculate congestion emissions, a weighted average of the emissions factors for each vehicle classification in the 1984 and 2010 fleets was determined. The vehicle classification weights were determined by the percentage of VMT traveled by each vehicle classification. These weights were multiplied by the corresponding emission factors for each pollutant, and the resulting weighted emission factors summed to determine a fleet emission factor for that pollutant. This factor (in grams/

1. Source: Air Resources Board paper An Emissions Analysis of the Sacramento Area Council of Governments Metro Study, dated December 1989

mile) was multiplied by the assumed congestion speed of 30 miles/hour. This provided a delay factor, which, when multiplied by the adjusted VHD, produced grams of pollutant per day. Grams per day were then converted to tons per day by dividing by 454 grams/pound and again by 2000 pounds/ton. While some concern has been expressed regarding the method used to calculate emissions due to congestion, it is important to note that a conservative estimate of 30 mph was used (a more realistic lower speed would have resulted in greater emissions numbers). Additionally, the congestion emissions accounted for less than 20 percent of the total emissions in almost all cases, with the exception of particulates in the 2010 base case wherein the congestion-related emissions accounted for 29 percent of total emissions.

Three additional scenarios were developed by the ARB. In the first, the effects of the cleaner 2010 vehicle fleet were examined by holding constant the VMT and trips assumed in the 1984 scenario and running the EMFAC7d model assuming a 2010 vehicle fleet. A second scenario represented the effects of the CCAA's mandate for significant reductions in the rate of growth of VMT and trips. In this case, the growth rate for VMT and trips was constrained to equal SACOG's population growth rate assumptions (i.e. 1984 population of 1,115,459; 2010 population of 1,937,708 produced a growth rate of 73.71 percent). The final scenario depicts current (1989) emission rates. VMT, trips and VHD were linearly interpolated based on 1984 and 2010 base case figures as given in the Metro Study. As in the 1984 case, daily VHD was calculated by multiplying peak hour vehicle hours of delay by two.

FIGURE C.1

METRO STUDY ALTERNATIVES EMISSIONS PROJECTIONS

	1984 Conditions	Build only projects with currently assured funding - 2010 "Base"	Alternative 1 Transportation control measures, transit response Emphasis: Mandatory TCM's LRT extensions	Alternative 2 Roadway facility response, major new facilities Emphasis: Rts. 65/148 (freeway) connecting I-5, Rt. 99, Rt. 50 & I-80	Alternative 3 Roadway facility response, major new facilities Emphasis: Rt. 102, I-5 & 99 to I-80 @ Auburn	Alternative 4 Roadway facility response, major new facilities Emphasis: Both Rt. 102 and Rts. 65/148 (freeway)	Alternative 5 Roadway facilities response, expand existing system Emphasis: Roadway Widenings Rts. 65/148 (arterial)	Alternative 6 Roadway & transit facility response, major new facilities Emphasis: LRT extensions, Mandatory TCMS, Rt. 102, Rts. 65/148 (freeway)
Estimated Total Daily Emissions[1]								
VMT (thousands)	21,873	49,636	45,413	48,523	48,195	48,439	48,090	45,713
Ozone Procursors (ROG & NO_x)	176	164	144	151	150	149	151	142
CO (tons/day)	648	555	497	526	524	523	525	494
Particulates (tons/day)	10	22	18	19	19	19	19	18
Estimated Emmissions due to:								
Vehicle Hours of Delay (Daily)[2]								
ROG (tons/day)	1.9	5.1	2.4	2.8	2.6	2.5	2.8	1.9
CO (tons/day)	21.1	41.4	19.8	22.8	21.2	19.9	22.9	15.7
NO_x (tons/day)	1.9	20.5	9.8	11.3	10.5	9.8	11.3	7.8
Particulates	0.1	6.4	3.0	3.5	3.2	3.1	3.5	2.4

[1]Source: California Air Resources Board, Memo November 1989. An Emission's Analysis of the Sacramento Area Council of Governments' "Metro Study".
[2]Estimated at 2 times peak period hours of delay in 1984, and three times peak period hours of delay in 2010.

FIGURE C.2

EMISSIONS PROJECTIONS REFLECTING

LIMITED REGIONAL GROWTH IN VEHICLE MILES TRAVELLED

ESTIMATED TOTAL DAILY EMISSIONS	NO GROWTH[1]	LIMITED GROWTH[2]	1989
VMT	21,873	37,996	27,212
Ozone Precursors ($ROG + NO_x$)	64	125	138
CO (tons/day)	256	455	528
Particulates (tons/day)	7	13	12
ESTIMATED EMISSIONS DUE TO DAILY VEHICLE HOURS OF DELAY (tons/day)			
ROG	0.7	1.8	2.0
CO	5.5	14.3	16.8
NO_x	2.7	7.1	4.4
Particulates	0.8	2.2	0.4

[1] No growth in daily VMT, improved vehicle fleet.

[2] Growth rate in VMT and trips equals population growth rate.

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